Request for information (RFI)

Title: Foreign Archive Conversion and Image Generation for Radarsat-1 Open data

1. BACKGROUND

Launched in 1995, RADARSAT-1 (R-1) was Canada's first Earth observation satellite and was used to acquire data over the Earth's surface to monitor natural resources and environmental change. This data is useful in many areas, including agriculture, cartography, hydrology, forestry, oceanography, geology, ice and ocean monitoring, arctic surveillance, and detecting ocean oil slicks.

R-1 followed a sun-synchronous orbit above the Earth with an altitude of 798 kilometers and inclination of 98.6 degrees. It used a synthetic aperture radar (SAR) sensor to image the Earth at a single microwave frequency of 5.3 GHz, in the C-band (wavelength of 5.6 cm).

Even though the R-1 mission is no longer collecting data after being declared non-operational in March 2013, the archived raw image data holds tremendous value as its time series span more than 16 years of continuous Earth Observation data, allowing a wealth of environmental analysis, for example, through making spatiotemporal comparisons with current data. It also helps us visualize the rate at which sea ice is melting in the north as a result of climate change.

2. PURPOSE OF THE RFI

The Canadian Space Agency (CSA) is looking for technical solutions to process R-1 raw data into useable image products.

This is neither a bid solicitation nor a preselection process. This request for information (RFI) will not result in the award of any contract; therefore, potential suppliers of any goods or services described in this RFI should not earmark stock or facilities, nor allocate resources, as a result of any information contained in this RFI. Nor will this RFI result in the creation of any source list; therefore, whether or not any potential supplier responds to this RFI, will not preclude that supplier from participating in any future procurement. Also, the procurement of any of the goods and services described in this RFI will not necessarily follow this RFI. This RFI is simply intended to solicit innovative ideas from industry, academia, and Canadian citizens with the possibility of becoming a significant and critical contribution to the opening R-1 archived data for commercial exploitation and scientific discovery.

The issuance of this RFI is not to be considered in any way as a commitment by Canada, or as authority for the Respondent to undertake any work which could be charged to Canada, nor is this RFI to be considered a commitment to issue eventual RFPs, enter into a private-public partnership or award eventual contracts in relation to this project.

Canada shall not be bound by anything stated in this RFI. Canada reserves the right to change all or any parts of this RFI as deemed necessary.

Canada will not be responsible for any cost incurred by Respondents in furnishing responses.

3. REQUESTED INFORMATION

Respondents are invited to consult Annex "A" in order to provide their response(s) to the requested information.

To facilitate the review of the responses, Respondents are asked to address and present the requested information in the order in which the topics are presented.

4. CONFIDENTIALITY

Respondents are advised that any information submitted to CSA in response to this RFI may be used by CSA in the finalization of a competitive request for proposals (RFP). However, the Government is not bound to accept any Expression of Interest or to consider it further in any associated documents such as an RFP.

All industry consultations will be documented and this information is subject to the Access to Information Act. Respondents should identify any submitted information that is to be considered as either company confidential or proprietary. CSA will not reveal any designated confidential or proprietary information to public and/or third parties, except for independent consultant(s) which may participate in RFI response review.

5. INDUSTRY CONSULTATION MEETINGS

Once responses are received and reviewed by CSA, Respondents may be invited to present and/or explain their responses at a Post RFI Response Submission Meeting with representatives of Canada, in St-Hubert. Such meeting will not result in the award of any contract.

CSA will not be responsible for any cost incurred to attend the meeting.

6. DELIVERY ADDRESS AND RESPONSE FORMAT

Responses to the RFI questions must be sent to the Procurement Authority, identified in Section 8 below, by e-mail. It is the sole responsibility of Respondents to confirm whether their RFI responses have been successfully received by Canada.

The electronic file formats of the responses must be in either Adobe Portable Document Format (PDF) TM or in a file format that is readable by the 2016 Microsoft Office TM Suite.

Provision of an electronic version is preferred in order to facilitate the distribution of the RFI responses to CSA reviewers.

7. CLOSING DATE

The closing date to submit a response is: February 26, 2020.

8. ENQUIRIES

Because this is not a bid solicitation, Canada will not necessarily respond to enquiries in writing or by circulating answers to all potential suppliers. However, Respondents with questions regarding this RFI may direct their enquiries to:

Julie Claveau
Mission Planner
Canadian Space Agency
6767 Route de l'Aéroport
Saint-Hubert, QC J3Y 8Y9
E-mail: julie.claveau@canada.ca

9. LANGUAGE

Responses and consultation meetings are to be provided or held in one of the two Official Languages of Canada (English or French).

ANNEX "A" – QUESTIONS

1 CONTEXT

The [Canadian Space Agency](#) (CSA) is looking for technical solutions to process RADARSAT-1 raw data into useable image products for free and open public use in line with Directive on Open Government. The Government of Canada (GC) welcomes innovative solutions and technologies.

Since the beginning of the RADARSAT Program, the CSA has been responsible for data acquisition and data processing, that is, the generation of images from raw satellite data, including R-1, while Natural Resources Canada (NRCan) has been maintaining the R-1 data archives. Until the end of the R-1 operations, both activities were performed to service Government of Canada R-1 data users.

Once acquired by the satellite and downlinked to ground stations, R-1 data was first stored in an unprocessed, raw data format archive managed by the Canada Centre for Mapping and Earth Observation (CCMEO), a branch of NRCan, and also in international satellite stations.

About 50% of the data is currently archived at CCMEO in a Shared Services Canada (SSC) data centre, of which 2% has already been processed into images. The public catalogue of raw data is accessible with the [Earth Observation Data Management System](#) (EODMS) through the Internet. Anyone can browse the R-1 raw data collection, which is composed of metadata, scene footprints and thumbnail imagery. Images which have already been processed can be downloaded at no cost.

The remaining 50% of the data is stored at foreign ground stations (some on physical media), which would also need to be processed into images, after being repatriated into the Canadian archives at CCMEO.

In order to get more familiarity with remote sensing aspects of the RADARSAT-1 system, Respondents are encouraged to consult the following document:

[http://www.google.ca/url?sa=t&rct=j&q=&esrc=s&source=web&cd=9&cad=rja&uact=8&ved=2ahUKEwiZ86XO5OTjAhU HneAKHbRTDxgQFjAIegQIAhAC&url=http%3A%2F%2Fforum.nasaspaceflight.com%2Findex.php%3Faction%3Ddlattach% 3Btopic%3D30814.0%3Battach%3D490001&usg=AOvVaw0eyhPEwksQXinpjOrOw0jV](#)

The CSA currently has a survey which aims to better understand the needs and preferences of Canadians with respect to RADARSAT-1 data. If you wish to contribute answers, please go to [https://forms.gle/QRpso98XpTj2fnHF6](#).

1.1 VOLUME

R-1 has an estimate of 1870000 scenes in total. We are currently processing anywhere between 300-1000 scenes per year (on demand). This volume is expected to increase, therefore demand management should be considered as an important aspect of the solution. As data is processed, it automatically becomes available for download.

1.2 IMAGE GENERATION

1.2.1 Processing Solution

The data downlinked and stored in Canada is in a raw format called Reconfigurable Frame Correlator (RFC) buffer format. Data from foreign stations will be made available in a Framed Raw Expanded Data (FRED) format. Both RFC buffer and FRED are open formats developed by MacDonald Dettwiler and Associates Ltd (MDA). Format specifications can be provided on request.

a. **RFC Buffer**

Each RFC buffer file is typically an entire satellite downlink containing multiple images with differing beam modes. The RFC data can either be in real time or playback. Real time is when satellite data was downlinked at time of acquisition, while playback data is data that was stored on the On-Board Recorder before being downlinked at a later time. In the case of playback, the downlink data is recorded in reverse.

b. **FRED**

The primary purpose of the FRED format is to provide a reliable, multi-sensor, multi-media type format for archiving signal data from Earth Observation satellites. The FRED format also enables signal data to be distributed to external users on a variety of media. The format is machine-independent.

2 INFORMATION REQUESTED

Below are requests and questions submitted to Respondents. Respondents do not need to answer every question and may propose more than one solution or business model. For quick access to specific sections, you may click on the link in the table below.

TABLE 1. Requests

RFI request 1	Respondents are requested to propose implementation(s) to this processing solution converting raw data from RFC and/or FRED format into any of the specified product formats in Table 2.	Link
RFI request 2	Respondents are requested to propose implementation(s) to bulk post-processing solutions for enhancing data valorization, usability and dissemination.	Link
RFI Request 3	Respondents are asked to propose solutions regarding the generation of Analysis Ready Data products.	Link
RFI Request 4	Respondents are invited to propose solutions for the delivery of, and access to, the processed data.	Link
RFI Request 5	Respondents are invited to propose any processing solutions along the following business model areas.	Link
RFI Request 6	Respondents are asked to provide cost estimates for their solution. These cost estimates should include development, operation, and maintenance.	Link
RFI Request 7	Respondents are asked to answer some general questions.	Link

2.1 IMAGE GENERATION

2.1.1 Required Processing Solution

This activity concerns the generation of Basic Products from raw data archived at Shared Services Canada.

In the context of a RADARSAT-1 open data solution, a processing solution should be able to input FRED formatted data, as well as convert RFC files into FRED. The solutions sought could be either on-demand or bulk processing (or both), and be scalable should demands increase. Please refer to **Error! Reference source not found.** for the data flow from raw data to image generation and Table 2 for the Basic Product types requested.

The processing solution should be able to generate products in one or all of the following formats (preference on GeoTIFF):

- **GeoTIFF** (https://earthdata.nasa.gov/esdis/eso/standards-and-references/geotiff)
  Cloud Optimized GeoTIFF (COG) could be something to consider as well.
- **CEOS** (http://ceos.org/document_management/Working_Groups/WGISS/Documents/WGISS_CEOS-Interoperability-Handbook_Feb2008.pdf

FIGURE 1. Data flow from raw data to image generation
(Black: Government Responsibility, Blue: Respondent Responsibility)
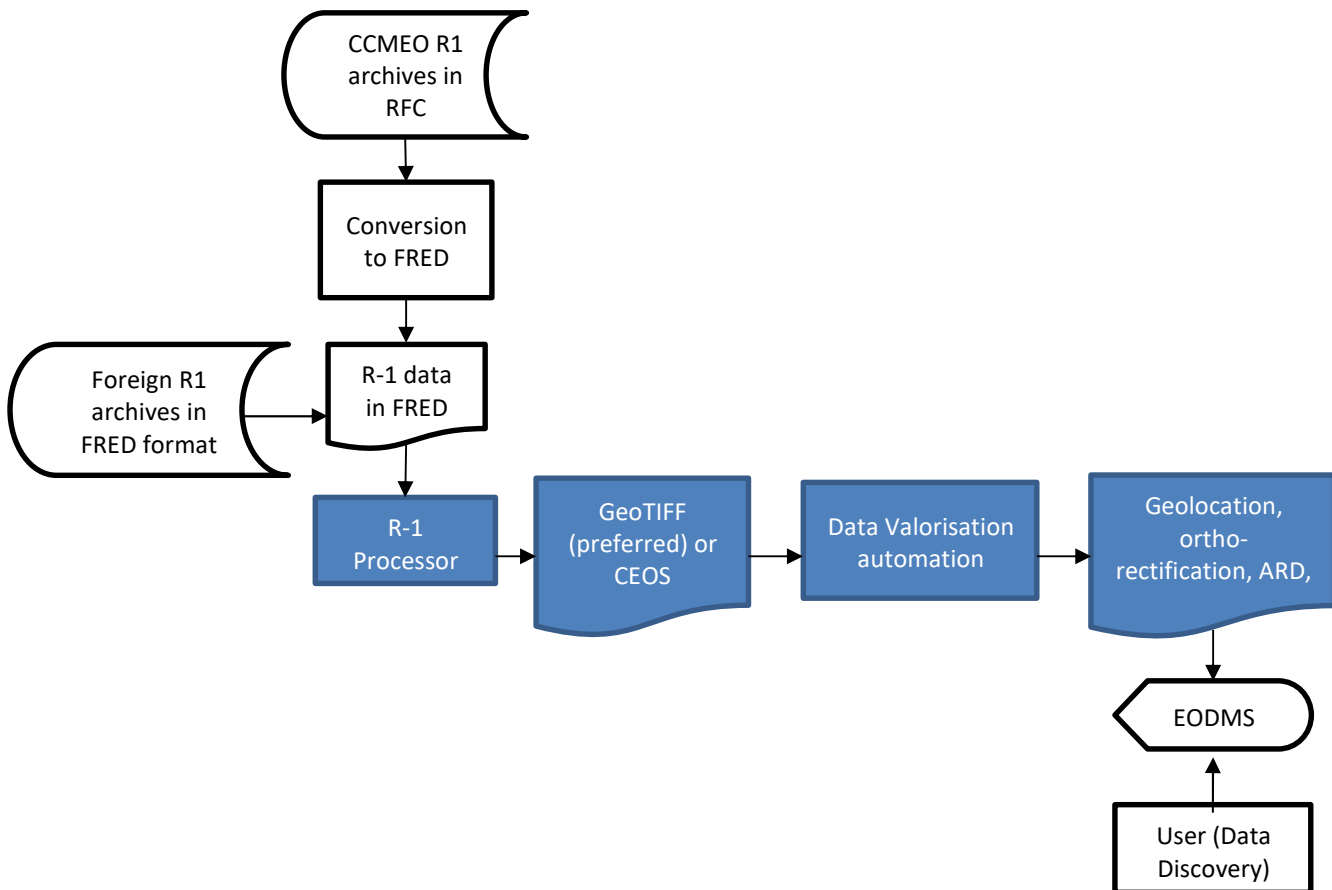
For reference, below are the different RADARSAT-1 Basic Product formats expected as outputs to the processing solution.

TABLE 2. RADARSAT-1 Basic Products

SLC	Single Look Complex product
SGF	SAR Georeferenced Fine Resolution product (Path Image)
SGX	SAR Georeferenced Extra Fine Resolution product (Path Image Plus)
SCN	ScanSAR Narrow beam product
SCW	ScanSAR Wide beam product

You can find more information on these RADARSAT-1 product specifications here:
https://mdacorporation.com/geospatial/international/satellites/RADARSAT-1 (click on RADARSAT-1 data sheet)

2.1.2 Data Valorisation

By contemporary Earth Observation standards, the RADARSAT-1 image products would benefit from post image generation enhancements to improve its usability and dissemination, especially for images acquired over land, which are deemed of interest to users. Please propose post processing solutions along the following lines:

1. Any process using complementary data to improve geolocation accuracy of R-1 products, and/or
2. Ortho-rectification,
3. Radiometric Terrain Correction,
4. Flood or vegetation mapping.

Post-processing enhancements such as the above are generally performed manually. However, automation would allow image generation enhancements to be executed in bulk. Proposed approaches to do this could be via artificial intelligence or machine learning solutions, although innovation is welcome.

2.1.3 Analysis Ready Data (ARD)

A next logical step to increasing the potential value of R-1 data could be to develop Analysis Ready Data (ARD) derived from the above mentioned data valorisation specifications.

- **Analysis Ready Data** (ARD) (http://ceos.org/ard/files/PFS/v4.1/CARD4L_Product_Family_Specification-Normalised_Radar_Backscatter-v4.1.pdf)

ARD would allow non expert decision makers to draw information from the data for example, through the use of analysis ready images forming a time series.

2.2 REQUIRED DELIVERY AND ACCESS

To enable public access and delivery, the solution may use any or all of the following technologies: conventional server access to data and products, cloud storage, cloud computing, APIs, or other.

2.2.1 Delivery

The processing solution would need to provide a delivery mechanism to the designated Government archive; server or cloud. The delivery mechanism could be either manual or automatic and should consider user access. Other mechanisms may be proposed.

2.2.2 Access

In the case of on-demand processing, a solution could enable users to:

- directly access the processing solution to process data on demand in a specific format, or;
- allow users to access the data directly without the need of a conventional graphical user interface or download.

2.3 BUSINESS MODEL

The Open RADARSAT-1 data solution may entail one or many of the following models. Respondents should clearly indicate which business model areas are of interest to them, also outlining the licensing and to clarify the intellectual property rights for the proposed solutions (image generation, post-processing for data valorization).

1. Processor:
   a. GC purchases an image processing solution developed by industry and proceeds with its deployment on GC premises, or;
   b. GC purchases image processing services through a contract with industry (on-site or remotely located).
2. Operations:
   a. GC operates the image processing system(s) (valid with 1. a. only) ; or
   b. Industry operates the Image processing system(s).

Maintenance and support is assumed to be supplied by industry in all cases.

2.4 COST MODEL

Since different solutions may be proposed, there are varying cost factors. Respondents are asked to enumerate all costs associated with their solution. Below are some questions to help guide cost estimates; these questions are in no way exclusive. If the proposed solution has other costs involved, please make them clear.

2.4.1 Development Costs
1. Cost for developing the processing system.
2. Cost for automatic interfacing with current search interfaces (SPA, EODMS, RCM OHS).
3. Cost for the installation of the processing system (either remotely, or on-site).

2.4.2 Operations Costs
1. Cost of operations if processor is operated by industry.
2. Cost of training if processor is operated by government.
3. Cost of image processing per product, on-demand and bulk. Provide a scalable cost solution.
4. Cost for data valorisation (geo localisation, ortho rectification, analysis ready data, etc.).
5. Cost of manual or automatic delivery of raw/processed data to the archives and/or user.

2.4.3 Maintenance Costs
1. Cost for software maintenance and customization.

2.5 GENERAL QUESTIONS
1. What is your level of experience and maturity in terms of processing SAR data?
2. Is your solution scalable? Explain. What is the cost evolution?
3. Would it be possible to install the processing solution on-site (government of Canada facility)?
4. What data format(s) would you produce?
5. Would you be providing processing on demand, bulk processing or both?

ANNEX "B" – Response Form

SECTION 1 - APPLICANT INFORMATION			
Legal name of the organisation			
Full name of primary contact		Full name of secondary contact	
Title / Position		Title / Position	
Address		Address	
Telephone	Fax	Telephone	Fax
Email		Email	

SECTION 2 – SIGNATURES			
Full name of authorised representative		Telephone	Fax
Title / Position		Email	
Applicants must send their proposed solution to Julie Claveau, using the address or email below: **Canadian Space Agency** **6767 Route de l'Aéroport** **Saint-Hubert, QC J3Y 8Y9** **E-mail: julie.claveau@canada.ca**		I declare that I am the duly authorised representative for the organisation. Signature Date	

ANNEX "C" – ACRONYMS

CCMEO : Canada Centre for Mapping and Earth Observation

CSA : Canadian Space Agency

EODMS : Earth Observation Data Management System

FRED : Framed Raw Expanded Data

GC : Government of Canada

HLD : High-Level Design

MDA : MacDonald, Dettwiler and Associates

NRCan : Natural Resources Canada

RFC : Reconfigurable Frame Correlator

RFI : Request for information

RFP : Request for proposal

R-1 : RADARSAT-1

SAR : Synthetic aperture radar

SSC : Shared Service Canada