

This document defines schedules, roles and responsibilities, exercise and rehearsal, mission guidelines and applicable documents for the CSA support of the second Antarctic Mapping Mission.

Comment [CADM1]: This template outlines the standard form and content of Manual and Maintenance Procedures. It can also be used as a basis for the production of other types of documents. For OARs, use the templates "w:\template\oar.dot" (Microsoft Word 97) or "w:\template\oar.wpt" (WordPerfect).

Satellite Operations

DRAFT

Modified Antarctic Mapping Mission - 2 (MAMM-2) Project Plan

DOCUMENT NUMBER

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1. INTRODUCTION

In September 1997, the Canadian Space Agency (CSA) and the US National Aeronautics and Space Administration (NASA) undertook the first Synthetic Aperture Radar (SAR) Antarctic Mapping Mission (AMM-1) of the southernmost continent. For a period of 18 days, the Antarctic Imaging Campaign, the CSA's RADARSAT-1 SAR satellite acquired data in a left-looking mode. This allowed data collection of the full extent of the continent.

As a result of optimum spacecraft performance during both the maneuver, and the imaging campaign, an additional 6 days of left-looking data were collected. This additional data-set provided the opportunity for interferometric studies of highly dynamic areas of the continent.

The CSA and NASA are preparing for a second mapping of the Antarctic continent using RADARSAT-1. This mapping, to be carried out in the right-looking configuration, over a period of three cycles, in fall 2000, will subsequently be known as the Modified Antarctic Mapping Mission-2 (MAMM-2).

During the period of MAMM-2, CSA has an obligation to continue support to other customers. MAMM-2 acquisitions, by definition, will be planned with a higher priority than routine requests, as given in Section 5.2. However, there may be circumstances for some urgent or time-critical requests where the prioritization will need to be revisited.

1.1 Purpose

The purpose of this document, the MAMM-2 Project Plan, is to establish the approach and level of support for the second Antarctic Mapping Mission.

The MAMM-2 Project Plan will be used to define the process used by CSA and the associated activities which will be managed by NASA.

1.2 Scope

This document provides details of the organization and operational policies for the execution of MAMM-2. It establishes the roles and responsibilities of each organization involved in the mission, defines schedules, exercise and rehearsal plans, and mission guidelines.

1.3 Acronyms

ARF	Anomaly Report Form
ASF	Alaska SAR Facility
AWOS	ASF Weekly Operations Schedule
BPRC	Byrd Polar Research Center
CCRS	Canada Centre for Remote Sensing
CSA	Canadian Space Agency
DAP	Data Acquisition Plan
GSS	Gatineau Satellite Station
JPL	Jet Propulsion Laboratory
MCF	Mission Control Facility

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Comment [CADM5]: The styles have already been defined including numbering (outline). To use these pre-defined styles, (e.g., Heading 1, Heading 2, Normal), move your insertion points to the left margin of the line on which you want to change a style. On Formatting toolbar (top left), click an appropriate style. To format numbering, choose **Bullets and Numbering** from **Format** menu, click **Outline Numbered** and choose an appropriate style.

Comment [CADM6]: A brief statement of the purpose of the procedure including, as applicable, where it fits within the overall hierarchy of procedures.

Comment [CADM7]: A clear and concise abstract of the coverage of the procedure, including general information on when it is to be used. The statement of scope should include, but is not necessarily limited to: System Context, Operation/Maintenance Context, Training, and Personnel.

MGS	McMurdo Ground Station
MMO	Mission Management Office
MWOS	MGS Weekly Operations Schedule
NASA	National Aeronautics and Space Administration
OBR	On Board Recorder
PASS	Prince Albert Satellite Station
RT	Real-time
SPA	Swath Planning Application
SRF	Scan Results File
TDRSS	Tracking and Data Relay Satellite System
USG	US Government
WOS	Weekly Operations Schedule

2. DOCUMENTATION

2.1 Applicable Documents

RADARSAT-1 Data Policy, RSCSA-PR0004

The International Memorandum of Understanding (IMOU) between the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the Canadian Space Agency.

Comment [CADM8]: This subsection provides a complete listing of all documents which are directly applicable to the procedure. The documents should be numbered consecutively as AD-1, AD-2, etc. Each listing should include the document identification and title. The listing should be preceded by a paragraph defining the extent of applicability and specifying the action to be taken in the event of conflict.

2.2 Reference Documents

RADARSAT-1 Antarctic 1 Mapping Mission Management Plan, RSCSA-PL0073

CSA/NASA Antarctic Mapping Mission Data Loss Re-Planning Procedures

Comment [CADM9]: This subsection provides a listing of those documents which may provide background information of help in executing the procedure, but which are not directly applicable. The documents should be numbered consecutively as RD-1, RD-2, etc. Each listing should include the document identification and title.

3. ROLES AND RESPONSIBILITIES

3.1 Definition of Partners

The partners in the MAMM-2 will be NASA and the CSA. In the context of this document NASA includes representatives from NASA HQ, Byrd Polar Research Center (BPRC), the Jet Propulsion Laboratory (JPL), Vexcel, and, the Alaska SAR Facility (ASF).

3.2 Definition of CSA Roles and Responsibilities

The MAMM-2 will be managed by the Director of Satellite Operations, supported by the System Operation Manager and the Operations Planning Manager, and their respective organizations.

CSA will be responsible for providing the following:

- An organization which allows for rapid distribution of mission status information and an efficient decision making process within the IMOU and Data Policy.

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- An operating satellite in the appropriate configuration for conducting the MAMM-2.
- The resources and facilities necessary to maintain satellite operations throughout the MAMM-2.
- The resources and facilities to ingest the acquisition plan as well as to prepare, and distribute, the operational products required to support the mission (i.e PCD, reception files, orbit files).
- The resources necessary to submit re-planned acquisitions as a result of data loss.

As the MAMM-2 does not require the spacecraft to be placed in the Antarctic configuration CSA will adhere to standard practices and procedures, as appropriate, during the MAMM-2 timeframe.

Within CSA Mission Planning, a Mission Operations Planning Procedure (MOPP) will define special considerations for MAMM-2. This document will address issues related to communication, replanning, non-US data into ASF, etc.

The management responsibilities are consistent with the CSA organizational structure and will remain in effect throughout the MAMM-2 period. The structure is defined in Figure 1.

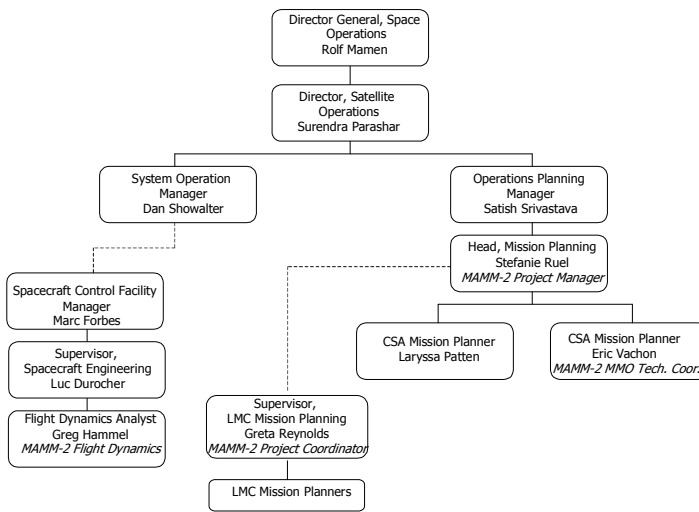


Figure 1. CSA Satellite Operations Organizational Structure

A CSA Project Team has been established to provide optimal communication with the NASA Team. This CSA team is defined in Figure 2. The primary points of contact for NASA during the MAMM-2 will be the Project Coordinator and the MMO Technical Coordinator.

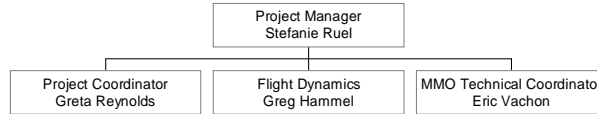


Figure 2. CSA MAMM-2 Project Team

The CSA Project Manager will be kept informed of all operations associated with the MAMM-2. The Project Manager will provide the resources necessary to accomplish the mission, and will ensure the objectives are met.

The CSA Project Coordinator will be responsible for providing smooth communication and operations between the NASA and CSA teams. The Project Coordinator will be the primary point of contact for NASA before and during the mission.

The MMO Technical Coordinator will be responsible for the interface with NASA on the DAP planning, plan submission, and execution. The Coordinator will provide NASA with the mission planning guidelines, MMO and spacecraft planning constraints, and will be responsible for attending RAF meetings, and working with the NASA team on replan opportunities including use of the Anomaly Report Form (ARF) to ensure adequate replanning.

CSA's Flight Dynamics Analyst will participate in pre-mission discussions related to orbit determination and orbit maintenance with representatives of NASA. During the mission the FDA is responsible for orbit maintenance.

CSA will designate an individual to be the point of contact with NASA on technical issues.

3.3 Definition of NASA Roles and Responsibilities

There will be a single point of contact for NASA, who will act as the Program Manager for the US efforts in preparation and implementation of MAMM-2. The NASA PM will ensure that all necessary US resources are made available and that all US tasks are completed as agreed.

NASA will be responsible for providing the following:

- An organization to prepare, and provide the final Data Acquisition Plan (DAP) for the mission.
- The resources to replan quickly in response to unforeseen anomalies that may occur during the mission.
- The resources to collect, analyze and report on the success of acquisitions in near real-time at each designated receiving station.
- The resources and facilities for handling, processing and distribution of all MAMM-2 data (data requested by the US specifically for MAMM-2) acquired during the mission.

- The resources and facilities for acquisition and distribution of all non-MAMM-2 data (data not requested by the US specifically for MAMM-2), to meet delivery specifications.
- A Technical Team with the objectives of:
 - assessing feasibility of meeting mission science objectives (coverage and interferometry)
 - recommending approaches for maximizing the chances for success
 - performing real-time data analysis and validation (coherence checking, baselines etc)
 - making recommendations for orbit control

4. DATA POLICY

4.1 General Mission Requirements

The MAMM-2 is defined by three successive RADARSAT-1 cycles. The RADARSAT-1 Data Policy will govern the planning, operations, and execution of MAMM-2.

- The health and safety of the satellite takes precedence over all other considerations.
- CSA shall manage, and be the final authority on all aspects of the conduct of the mission, including orbit control.
- The imaging shall not exceed 72 days (3 cycles).
- The earliest start for MAMM-2 shall be 3 September, 2000 (cycle 73).
- The orbit will be maintained throughout the MAMM-2 (i.e. unchanged node and nominal +/- 5 km ground track).

4.2 Mission Planning

Mission Planning, in the sense of generating the Data Acquisition Plan (DAP) will be performed by NASA, with concurrence by CSA. Mission Planning, in the sense of conflict resolution, down-link scheduling, generating the PCD and all operational files, will be performed by CSA.

- The NASA team will provide a copy of the final DAP to CSA. Submission of the final DAP will be through the US Government Order Desk, located at the Alaska SAR Facility. The DAP submission will follow the standard submission procedures and timelines.
- Any replans, required due to an anomalous situation, will be generated by the NASA MAMM-2 team on-site at CSA, and submitted by the MAMM-2 MMO Technical Coordinator. This will facilitate timely planning and submission.
- Re-plans will be submitted by the NASA Team, to the MMO Technical Coordinator, no later than 1300 UTC; otherwise it will not be executed.
- Data will be collected in real-time and by using the on-board recorder. Where available, all data will be down-linked real-time.

- Maximum use will be made of the McMurdo Ground Station (MGS). In the event of a station failure at MGS, the mission will be supported as a mapping mission, with a best effort toward interferometric acquisitions.
- A total of 2400 minutes of SAR On-Time, above the US allocation of 1519 (real-time + OBR) SAR On-time per cycle, will be allotted for MAMM-2 and MAMM-3. The use of these additional resources will be at NASA's discretion.
- A total of 300 minutes of OBR time, above the US allocation of 114 minutes per cycle, will be allotted for MAMM-2 and MAMM-3. The use of these additional resources will be at NASA's discretion.
- CSA will acquire and provide Amazon calibration images for MAMM-2 beam requirements (F1, S1, S2, S6 and EL1)
- The following planning priorities will be maintained during the mission:
 - Priority 1 Spacecraft / Payload Health and Safety
 - Priority 2 Emergencies at CSA's discretion
 - Priority 3 Calibration Investigation and Amazon calibration images for MAMM-2
 - Priority 4 Time Critical Acquisitions
 - Priority 4.1 MAMM-2 Acquisitions and Canadian Ice Service Acquisitions
 - Priority 4.2 Commercial
 - Priority 4.3 Non-commercial
 - Priority 5 Non-Time Critical
- The following priorities will apply to the use of the OBR during the mission:
 - OBR 0 Emergencies at CSA's discretion
 - OBR 1 AMM Acquisitions
 - OBR 2 Other Acquisitions

4.3 Data Acquisition

- Data will be down-linked at the Canadian Reception Facilities in Gatineau, Quebec (Gatineau Satellite Station - GSS), and Prince Albert, Saskatchewan (Prince Albert Satellite Station - PASS), as well as the US Reception Facilities in Fairbanks, Alaska (Alaska SAR Facility - ASF) and McMurdo, Antarctica (McMurdo Ground Stations - MGS).
- Each station (ASF, MGS, GSS, PASS) will perform some level of data quality analysis to ensure data capture. This will include FastScan at the Canadian stations, scanning/quick-look processing at ASF, and DQM at McMurdo.

- Each Canadian station will have a NASA representative on hand during the mission to assist with data analysis and tape shipment.
- The DQM Summary, will be sent from McMurdo to ASF and CSA, and will be considered as the Post Pass Summary during the mission.
- All MAMM-2 data will be sent to ASF for processing.
- All non-US data down-linked to ASF during the mission will be expedited to CDPF for processing, and delivery to the customer, per delivery specifications.

5. Exercises and Rehearsals

A period of exercises and rehearsals will be undertaken to ensure mission readiness. These activities will range from mission planning, to re-planning, to data acquisition. While the operational procedures will not vary widely from standard defined procedures, these activities will ensure the readiness of all parties involved. All output, and results, from the exercises and rehearsal will be verified and documented.

5.1 Mission Planning

- MP-1 Requests submitted by US Government Order Desk (ASF)
- html files submitted to ASF
 - ASF submits requests using autosubmit/autoapprove (standard ASF procedures)

Expected Result: All requests are successfully ingested to the MMO/DBM

- MP-2 3 orbit payload outage requiring replanning
- CSA Mission Planning informs NASA team of outage
 - NASA team replans and submits to Technical Coordinator
 - Technical Coordinator submits to MMO
 - CSA Mission Planning generates and transmits new reception schedule (.rsh)
 - CSA Mission Planning informs reception facilities of new schedule/files

Expected Result: New requests are planned and successfully submitted to MMO/DBM. New schedules are generated for the reception facilities.

- MP-3 24 hour payload outage requiring replanning
- CSA Mission Planning informs NASA team of outage
 - NASA team replans and submits to Technical Coordinator
 - Technical Coordinator submits to MMO
 - CSA Mission Planning generates and transmits new reception schedule (.rsh)
 - CSA Mission Planning informs reception facilities of new schedule/files

Expected Result: New requests are planned and successfully submitted to MMO/DBM. New schedules are generated for the reception facilities.

MP-4 Generation, delivery and ingestion of reception files, followed by generation and delivery of WOS to MGS and ASF tracking systems

- CSA Mission Planning generates and transmits .rrq and .rsh files for test period
- ASF ingests .rrq and .rsh files
- ASF generates AWOS and MWOS
- ASF delivers AWOS and MWOS

Expected Result: ASF successfully delivers WOS for ASF and MGS

MP-5 Set up of TDRSS link

- ASF informs WFF about acquisitions requiring TDRSS
- WFF schedules TDRSS link
- Data is acquired and sent via TDRSS to White Sands

Expected Result: Data is acquired and sent to White Sands via TDRSS.

5.2 Data Acquisition and Handling

DA-1 Reception of MAMM-2 data at ASF

- ASF acquires downlink containing only MAMM-2 data
- ASF scans, and quick-look processes, data for data quality and coverage
- ASF creates SRF (or similar)
- ASF sends SRF to CSA NASA Team
- ASF sends Post Pass Summary to CSA

Expected Result: Data acquired, scanned, QL'd and results sent to CSA

DA-2 Reception of non-urgent, non-MAMM-2 data at ASF

- ASF acquires downlink containing non-MAMM-2 (non-USG) data
- ASF transcribes data (or writes in real-time) to Sony D1
- ASF expedites shipment of data to CDPF for processing

Expected Result: Data acquired and sent to CDPF...2 day turn around

DA-3 Reception of urgent, non-MAMM-2 data at ASF (ASF to processing)

- ASF acquires downlink containing non-MAMM-2 (non-USG) data
- ASF QLs data and ftps to CDPF
- ASF expedites shipment of data to CDPF for processing

Expected Result: Data acquired, processed and ftp'd to CDPF. Raw data sent to CDPF.

DA-4 Reception of MAMM-2 data at PASS or GSS

- GSS/PASS acquires MAMM-2 data
- OSU staff on-site at GSS/PASS uses FastScan to check data
- OSU staff on-site at GSS/PASS ftps SRF to CSA NASA Team and ASF
- OSU staff on-site at GSS/PASS Fed-Ex tapes to ASF

Expected Result: Data acquired, FastScanned and results sent to CSA and ASF. Data shipped to ASF.

DA-5 Reception of data at MGS

- MGS acquires data
- MGS sends DQM summary to CSA and ASF
- MGS sends data to ASF when possible

Expected Result: Data acquired and results sent to ASF and CSA.

DA-6 Reception of data at MGS - TDRSS/DomSat required

- MGS acquires data
- MGS sends DQM summary to CSA and ASF
- MGS sends data via TDRSS to White Sands
- White Sands sends data via DomSat to JPL

Expected Result: Data acquired, results sent to ASF and CSA, and data sent out via TDRSS.

6. SCHEDULE - schedule attached.