RADARSAT: The Antarctic Mapping Project

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I. Introduction

On November 4, 1995, the Canadian RADARSAT was carried aloft by a NASA rocket launched from Vandenberg Air Force Base. RADARSAT is equipped with a C-band Synthetic Aperture Radar (SAR) capable of acquiring high resolution (25 m) images of Earth's surface day or night and under all weather conditions. Along with the attributes familiar to researchers working with SAR data from the European Space Agency's Earth Remote Sensing Satellite and the Japanese Earth Resources Satellite, RADARSAT will have enhanced flexibility to collect data using a variety of swath widths, incidence angles and resolutions. Most importantly, for scientists interested in Antarctica, the agreement for a U.S. launch of RADARSAT includes a provision for rotating in orbit the normally right-looking SAR to a left-looking mode. This 'Antarctic Mode' will provide for the first time a nearly instantaneous, high resolution view of the entirety of Antarctica on each of two proposed mappings separated by 2 years. This is an unprecedented opportunity to finish mapping one of the few remaining uncharted regions of the Earth. The completed maps will also provide two important benchmarks for gauging changes of Antarctica's ice cover (Jezek and Carsey, 1993).

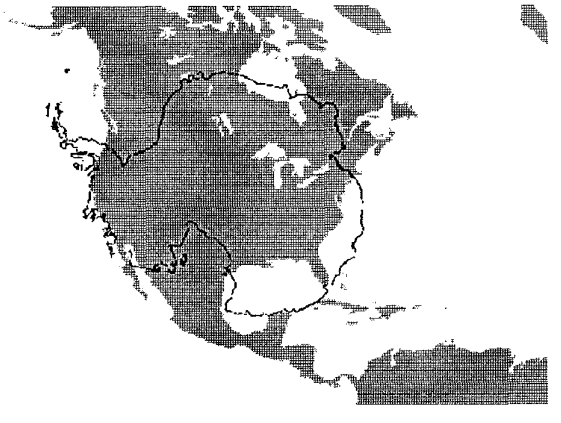

Figure 1. The area of Antarctica to be mapped is equivalent to that of the United States and Mexico combined.

II. Project Plan

The preparation of a digital mosaic of Antarctica is being conducted by the Byrd Polar Research Center of The Ohio State University under a NASA Pathfinder Project. The primary goal of the project is to compile digital SAR mosaics of the entire Antarctic continent using a combination of standard and extended beams during the "Antarctic Mode" of the RADARSAT Mission (figure 2). Preliminary plans

Figure 2. Map showing 3 days of standard beam 2 coverage. Mapping to the South Pole will be completed with extended beam 4. Ascending swaths will be used to compile the mosaic.

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call for the first Antarctic Mapping Maneuver to occur in October, 1996. A mission plan to coordinate that complex acquisition and downlinking of Antarctic data is being developed by NASA's Jet Propulsion Laboratory and the Canadian Space Agency. The plan indicates that a minimum of 18 days are required to completely image the continent using standard beams 2 through 7 and extended beam 4 for imaging the Pole (figure 2). Contingency plans are in preparation in the event of unforseen complications during the data acquistion.

The Alaska SAR Facility (ASF) will be used as the primary data collection site supported by collections at the Canadian Gatineau and Prince Albert Ground Stations. ASF will process data into images which will be sent to OSU for compositing into map products using equipment under design by Vexcel Corporation of Boulder, Colorado. Final products will be distributed through the ASF and the National Snow and Ice Data Center which are both NASA Distributed Active Archive Centers (DAACs). The mosaics and ancillary information will be prepared on CDROM and will be made available to the science community through NASA DAACs.

III. Science Opportunities

The international research community is providing guidance through the Antarctic Mapping Advisory Group. AMAG is tasked with helping assure that science opportunities envisioned for the program (as summarized on table 1) can be achieved with the mission plan, data reduction algorithms and final product suite. These opportunities include studying the dynamics and variability of the Antarctic Ice Sheet including studies of regions like the Wordie Ice Shelf and the Larsen Ice Shelf which have recently experienced unexplained and very rapid retreat. Geologic applications include large scale mapping of faults, volcanic features, and studies of mountain building processes (particularly the Transantarctic Mountains). Data are also expected to assist in the development and implementation of policies for managing the Antarctic environment (Jezek and Everett, 1995). Finally, there is simply the unprecedented opportunity to use these digital maps in studies of many previously unexplored areas of the Southern Continent.

Table 1

RADARSAT: THE ANTARCTIC MAPPING PROJECT
SCIENCE OPPORTUNITIES

GLACIOLOGY

* Ice sheet/stream flow regimes (fast glacier flow, relict features, outlet glaciers)
* Stability of West Antarctic Ice Sheet (grounding lines, surface velocities)
* Ice sheet mass balance (calving rates, ice sheet margins, topography)
* Surface melt regimes

GEOLOGY

* Uplift of the Transantarctic Mountains (Fault and lineament mapping)
* History of subduction beneath the Antarctic Peninsula
* Geologic mapping (Sirius Formation)
* Vulcanology

GEOMORPHOLOGY

History of glaciation (moraines, raised beaches)

ENVIRONMENTAL MONITORING

* Fuel spills
* Camp and airstrip construction

Figure 3. This JERS-1 scene of Ross Island, Antarctica (center) illustrates the kind of imagery that will be incorporated into the RADARSAT digital mosaic. Shear lines appear diagonally across the Ross Ice Shelf (lower right). The bright finger of ice (left center) extending from Ross Island is the Erebus Ice Tongue. McMurdo Station is located on the tip of Hut Point Peninsula (left center). The bright patch of intersecting lines just to the lower right of McMurdo Station is the Williams Field airstrip.

IV. References

1. Jezek, K.C., and F.D. Carsey, 1993. RADARSAT: The Antarctic Mapping Project. Byrd Polar Research Center Report no. 6, 24p .

2. Jezek, K.C., and L. Everett, 1995. Managing the Antarctic Environment: From Observations to Policy. Byrd Polar Research Center Report no. 12, 42 p.