Building an Integrated View of Antarctica Using Measurements from the Radarsat-1 Antarctic Mapping Project

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From the IGY through the early 1970's, scientific knowledge about Antarctica was gleaned primarily from observations made at points along traverse routes or along sparsely spaced aircraft flight lines. Analysis of these observations provided tantalizing clues about the nature and behavior of the ice sheet and the bedrock beneath. But the data themselves could not provide a continental scale assessment of how different glaciological and geophysical regimes interacted.

The situation changed in the mid-1970's with the launch of several active and passive sensors on satellites positioned in polar orbit. While these instruments obtained continent-wide coverage, the resolutions ranged from a few kilometers to a few 10's of kilometers. Moreover, only the microwave instruments could obtain data day-or-night and under all-weather conditions. None of the instruments alone or together could provide important large-scale information on several key geophysical variables including 3-dimensional estimates of surface velocity.

For that reason, NASA and the Canadian Space Agency began planning in the early 1980's for an imaging campaign using the Synthetic Aperture Radar to be carried by RADARSAT-1. The technical goals set forth in the early planning were first to obtain a complete high-resolution radar mapping of Antarctica, which was accomplished in 1997. A second campaign began in September 2000 with a modified set of technical and scientific goals directed towards using interferometry to map as much of the surface velocity field as possible. To compensate for the increased load on the satellite and the extra efforts by the spacecraft operations team, the coverage would extend from about 80o S to the coast.

The resulting RAMP Antarctic image mosaic has been used to map the coastline of the continent in great detail, to study and contrast glaciological regimes about the continent, and to examine glaciological process such as the evolution of ice shelves by observing ice shelves at various stages of development about the continent. But a single instrument or data set alone is rarely ever able to answer complex scientific questions. For that reason it is interesting to use the RAMP mosaic as a basis for integrating other continental scale observations into a common framework referencable to features observable on the surface. Here, we have assembled several continental data sets into a Geographic Information System format. Using the RAMP mosaic as a base map, we compare surface topography patterns using the Digital Elevation Model developed as part of RAMP, BEDMAP compiled basal topography, the RAMP model of surface balance-velocities, and RAMP derived surface velocities. We show for example, how the radar imagery might be used to infer information about subglacial topography and where there are complexities in the surface velocity field. We also show how related products, such as interferometric coherence, can be used to locate shear margins along ice streams and identify the grounding line between the interior ice sheet and ice shelves.