Editor's Note:
The cover of our November 1996 issue (11, 11) carried the very first image received from RADARSAT together with a detailed explanation.

The Radarsat Antarctic Mapping Mission

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The Radarsat Earth-observation satellite was launched on November 4, 1995 aboard a Delta 2 rocket from Vandenberg Air Force Base in California. It is operated from the Canadian Space Agency (CSA) in Saint-Hubert, Québec by a mission operations team consisting of CSA personnel and contractors from SED Systems, Oerlikon Aerospace, AlliedSignal, and Lockheed Martin. The satellite was designed and built in Canada by a team of thirty companies led by prime contractor Spar Aerospace.

Equipped with a sophisticated synthetic aperture radar (SAR), Radarsat can produce images of extraordinary clarity even through clouds, smog, haze, smoke, and darkness. As illustrated in Figure 1, on next page, the SAR has a variety of operating modes. It can be adjusted to produce swathes between 35 and 500 km in width, with ground resolutions from 100 m to as low as eight. In addition, the beam can be steered at angles up to 49° from the satellite's nadir vector, giving it the unique ability to image areas it is not directly overflying.

In exchange for the launch, CSA agreed to provide NASA with access to the SAR data, and to execute a 180° yaw-around of Radarsat twice during its lifetime to map the Antarctic continent. The first of these Antarctic Mapping Missions, dubbed AMM-1, began with the "entry" maneuver on September 9, 1997. Approximately 48 hours later, the satellite's normally right-facing SAR array had been successfully rotated into a left-looking attitude. After a two-week checkout and commissioning period, Radarsat commenced AMM-1 operations on September 26.

Remarkably, the Antarctic continent – a landmass about the size of the United States and Mexico combined – had never before been fully mapped in high-resolution. Due to a combination of factors, including orbital inclination and the incidence angle of the instruments, previous satellites were unable to image the South Pole. Though some optical satellites could look below 80°S latitude, their observations were limited because the area is usually obscured by clouds. Almost 70% of the Earth's fresh water is contained in the south polar region, and any changes in that enormous reservoir will directly influence world sea levels and climate. Thanks to Radarsat, scientists now have the most comprehensive data set ever compiled on this crucial part of our planet's ecology.

The images produced during AMM-1 can only be described as spectacular. Figure 2, on next page, is a very high-resolution image of the South Pole taken on September 14. The bright radar returns correspond to structures that are part of the Amundsen-Scott Station, which has been operated by the National Science Foundation since 1956. Evident in the SAR image is a long line extending from the station to the upper-right. This is a highway that leads to an abandoned antenna site. The principal base facilities are located within the cluster of returns near the lower-left end of the highway. Just below this cluster is a 4.3 km long skyway that appears as a bright

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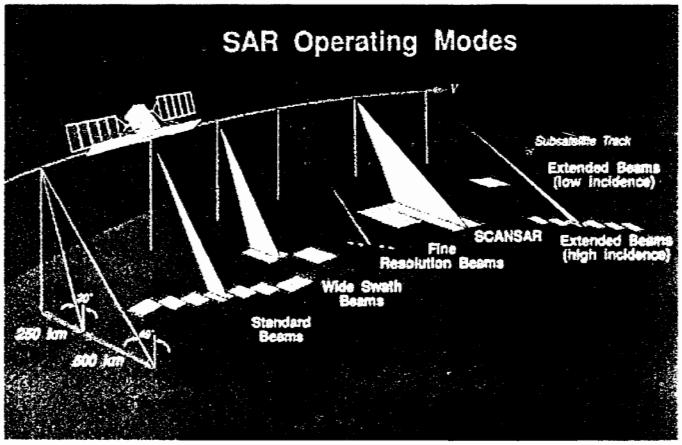

Fig. 1. SAR Operating Modes

Land. The glacier is splitting into several elongated tongues that are spilling out into the adjacent Ross Sea. Icebergs calving from glaciers like Mariner is the primary mechanism by which ice accumulated in the Antarctic interior is eventually lost to the sea. Knowledge of iceberg production is vital for calculating the ice sheet mass balance, which will help scientists determine whether the south polar cap is growing or retreating.

By the conclusion of the primary imaging campaign on October 14, it was clear that AMM-1 had been a success beyond all expectations. The science team had baselined 5000 images as the minimum required to map the continent; Radarsat produced over 8000. A further 2000 frames of interferometric data were also acquired during extended imaging operations. These will enable

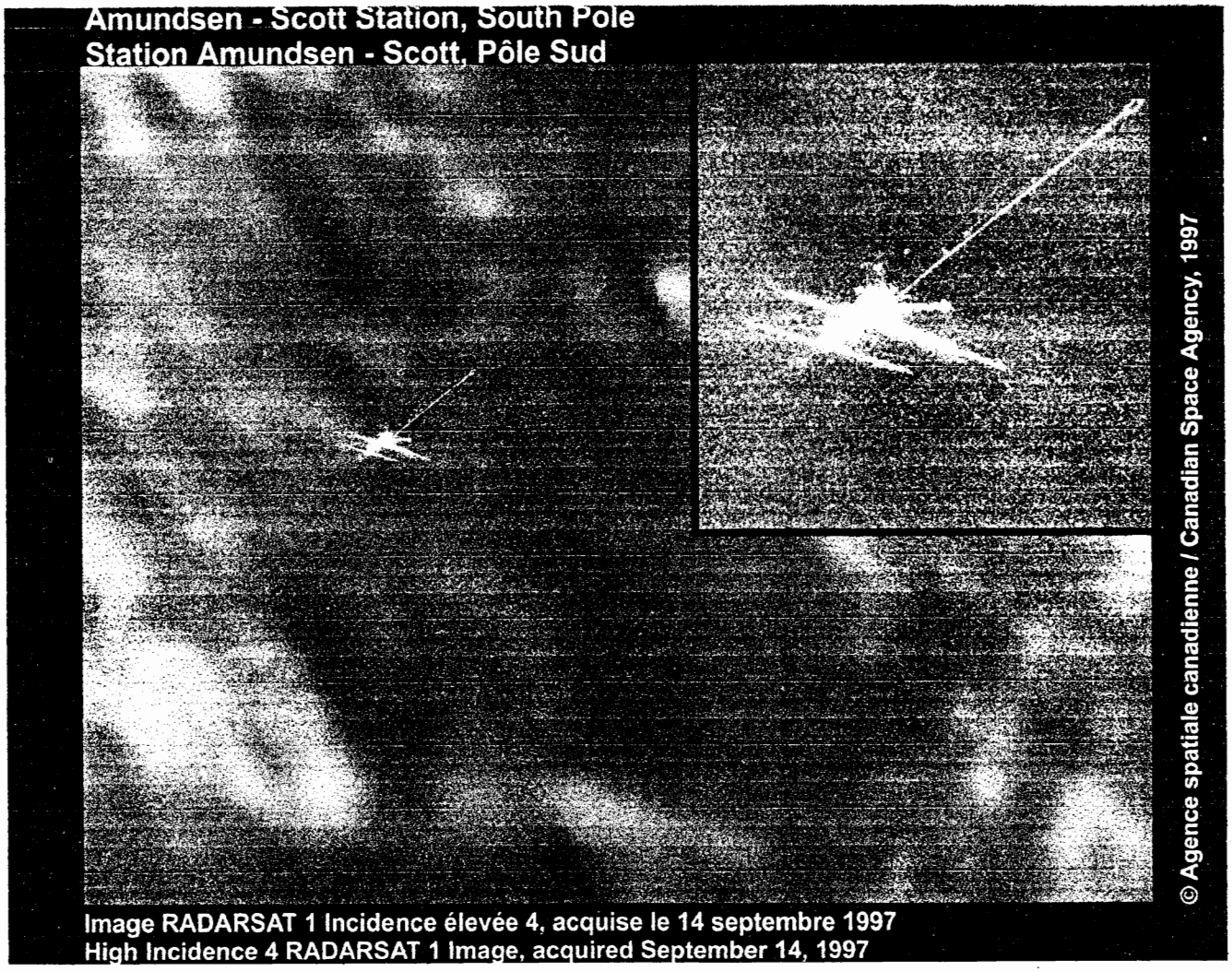

Fig. 2. Radarsat Image – September 14, 1997

band. The geographic South Pole is located between the skyway and the station. Parallel to this band is a dimmer line that is a second, older skyway. The bright returns between the two are reflections of abandoned structures now buried under 10 m of snow.

Taken on October 4, Figure 3, on next page, shows the Mariner Glacier expanse across northern Victoria

scientists to create high-resolution topographic maps of most of the major relief features and generate better estimates of glacial flow rate. The AMM-1 data is currently being processed by NASA's Alaska SAR Facility at the University of Alaska. Once this is done, the Byrd Polar Research Center at Ohio State University will compile the images into a complete mosaic of Antarctica.

Fig. 3. Radarsat Image – October 4, 1997

With AMM-1 completed, Radarsat was rotated back to its nominal attitude to resume routine imaging. The "exit" maneuver, which commenced on October 20, was not without some excitement. A horizon scanner glitch confused the attitude control system, triggering a safe-hold mode condition. The mission operations team quickly recovered from the problem, and by the evening of October 21 Radarsat was back in its original "Arctic" mode. The SAR was reactivated on October 23, and the first test image was taken a day later. Following a series of calibration and recommissioning activities Radarsat resumed nominal operations on November 4, which happened to be the second anniversary of its launch.

AMM-2, the next South Pole mapping campaign, is tentatively scheduled to occur in the autumn of 2000. This will produce an invaluable second data set to complement the AMM-1 images. In so doing, the Radarsat satellite will again demonstrate one of the most important benefits of the space program – helping us take better care of our pale blue planet.