Interferometrically Derived Topography, Velocity, and Ice-Flux Estimates for the Peterman Glacier

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Since the launch of the ERS-1 synthetic aperture radar (SAR) several authors have demonstrated that satellite radar interferornetry (SRI) is a method capable of accurately measuring ice-sheet velocity and surface topography. The dense sampling and coincident motion and topography data sets make interferometry a powerful tool for glaciological research. We have applied this technique using interferograms formed from pairs of ERS- 1 SAR images to map the topography and flow of the Peterman, which is a large outlet glacier in northwestern Greenland. The interferograms reveal that stream flow associated with the Peterman extends more than 160 km inland with a stream-width of approximately 20-30 km. The location of the grounding line is easily determined from the interferograms.

By differencing pairs of interferograms we are able to cancel motion and, thus, estimate topography. The resulting elevation model reveals several dynamically-supported features on the ice sheet surface, Wc remove the effect of topography from the mixed topography and motion interferograms to form motion-only interferograms. We then use stationary bedrock points as zero-velocity references to convert relative values to absolute estimates of velocity, Using data from parallel SAR swaths we are able to measure in detail (i.e., 80 m spacing) the velocity field of the Peterman from 160 km inland near the onset of rapid flow to an area a few kilometers upstream of the grounding, line.

Using surface topography, velocity profiles transverse to the direction of flow, and an estimate of the bed topography we are able to estimate ice flux upstream of the grounding line, where the ice is moving at several hundred m/yr. Using this type of data it should be possible to assess the mass balance of individual drainage basins.

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