F2: Remote Sensing of Ice Sheets

Radar interferometric studies of the Greenland Ice Sheet.

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Synthetic-aperture radar interferometry has shown tremendous potential for polar research by offering the unique opportunity to measure both meter-scale surface topography and millimetric daily ice motion of polar ice sheets, at an unprecedented level of spatial details, over vast and remote areas. Several examples of application of this technique are discussed in the case of the Greenland Ice Sheet. In south-western Greenland, in the midst of the featureless percolation facies, we retrieved both surface velocity and topography and compared the results with in-situ velocities collected along a 40 km segment using GPS. In North Greenland, we located the hinging zone of Petermann's Gletscher within 100 m, separated tidal flexure from topography and horizontal motion, and derived a net 11(,1(11(1) to estimate the calving flux of calving glaciers with SAR interferometry alone. The technique was utilized to estimate the grounding lines and calving fluxes of major outlet glaciers of south-eastern Greenland, the least well-known remaining portion of Greenland.

Topographic mapping of polar ice sheets has been less successful than ice velocity mapping because of decorrelation features in the ERS-1 data, random propagation delays, baseline uncertainties, and unknown penetration depth of the radar signals. To answer the question of penetration depth, an airborne campaign was launched in May 1995 using the NASA/JPL TOPSAR instrument equipped with both C (5.6 cm) and L-band (24 cm), dual-antenna, radar interferometers and a third antenna operating at P-band (68 cm). Several thousand kilometers of data were collected along all the major snow facies of the Greenland Ice Sheet, several major outlet glaciers and ice-streams, as well as the summit camps. Processing of these data is still in progress. The resulting topographic maps will be compared to laser altimetry data collected at the same time by the NASA/Wallops /?01 instrument. The results will determine the performance of SAR interferometry at mapping surface topography across different glaciological regimes and will help evaluate the merits and values of 3 radar frequencies for interferometric monitoring of polar ice sheets.