Sea Ice Polarimetric Backscatter Signatures at C Band

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This paper presents C-band polarimetric backscatter signatures of sea ice measured during CRRELEX (Cold Regions Research and Engineering Laboratory Experiment) from 1993 to 1995. Observed radar backscatter of sea ice is related to sea ice physical characteristics. Complex scattering models for sea ice are developed and used to interpret measured radar data with sea ice physical parameters. These results for sea ice at C band are important for applications to remote sensing data acquired with airborne polarimetric synthetic aperture radars (SAR) such as the Jet Propulsion Laboratory (JPL) Aircraft SAR and spaceborne radars such as the Spaceborne Imaging Radar, the European Remote Sensing Satellites (ERS-1 and ERS-2), and the Canadian Radar Satellite (RADARSAT); all operate at C band.

In CRRELEX 1993, saline ice was grown under the quiescent condition at constant, air and water temperatures to measure the polarimetric signatures during the ice growth. A constant growth rate was achieved and the backscatter was shown to be sensitive to ice thickness with an increasing trend. We also investigated effects of ice warming, flooding, and slush layer. CRRELEX 1994 was carried out in January 1994 at the CRREL **outdoor** Geophysical Research Facility. An ice sheet was grown in 2.5 days for ice thickness of 10 cm and the polarimetric radar was used to obtain backscattering data interlacingly with passive measurements in conjunction with ice-characterization measurements. The results reveal a strong correlation between radar data and temperature variations throughout two diurnal thermal cycles. We also studied backscatter from bare sea ice, snow cover effects, and different surface roughness in CRRELEX 1994. In CRRELEX 1995, frost flowers were grown during the growth of the saline ice from both unseeded and seeded initial conditions; more than 90% areal coverage of frost flowers was achieved at the controlled air temperature of - 28° C. The experiment determined that the frost flower formation enhances backscatter by 3-5 dB over the background ice layer. For the outdoor ice, polarimetric backscatter from pancake ice was measured. Desalination effects in the 30-cm thick ice sheet were investigated with polarimetric backscatter data collected before, during, and after the development of large systems of brine drainage channels. The second outdoor ice sheet was grown from open water to approximately 5-cm thick for interferometric radar measurements with several baselines as a function of ice thickness. The experiments provide the data base for forward and inverse model development and verification to interpret sea ice remote sensing data.