

**POLARIMETRIC BACKSCATTERING SIGNATURES FROM THIN SALINE ICE
UNDER CONTROLLED LABORATORY CONDITIONS**

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We carried out an experiment to measure polarimetric backscattering signatures from thin ice at the U.S. Army Cold Regions Research and Engineering Laboratory. Two ice sheets were grown in an indoor pit with the air temperature kept about -20°C to simulate the cold arctic condition.

During the growth of the two ice sheets, a C-band polarimetric scatterometer was used to collect backscattering data at centimetric increments for ice thickness up to 12 cm. Full polarimetric scattering matrices were measured as functions of incident angles during the ice growth. From the scattering matrix measurements, polarimetric backscattering coefficients, covariance matrices, Mueller matrices, and polarization signatures of the thin ice are obtained.

Moreover, a number of measurements were carried out on various modified ice conditions. Polarimetric signatures of frost flowers were investigated by measuring backscatter with all frost flower constituents, then with the fluffy frost, ice taken away, and with the rough frost bases removed. Ice warming experiment was carried out with polarimetric scatterometer measurements before and after the ice temperatures stabilized to a linear profile with respect to ice depth. Flooding of the ice sheets was also studied with backscatter measurements for two flooding events under cold and warm ice conditions; an increase in radar return was observed at normal incidence in both cases. When the flooding brine layers froze and became slush layers, polarimetric measurements were taken to study slush layer effects. Ice thickness and temperature were measured in situ and ice samples were taken for salinity measurements and structure analyses with the thin section method to relate ice characteristics to the microwave polarimetric signatures.