# Characterization of Internal layers and Basal Conditions at the WAIS Divide Drill Site using a VHF Surface Based Radar

*Blake, W.A., Laird, C.M., Gogineni, S., Allen, C.T., Leuschen, C.J., and Braaten, D.A.*

*Center for Remote Sensing of Ice Sheets*
*University of Kansas*
*Lawrence, Kansas 66045 USA*

Ice thickness, deep internal layers some more than 3 km and the ice-bed interface around the West Antarctic Ice Sheet (WAIS) divide deep drill site have all been mapped simultaneously at a fine resolution with an ultra-wideband, very high frequency (120 to 300 MHz) ground based radar. The radar was built by the Center for the Remote Sensing of Ice Sheets (CReSIS) as part of the Polar Radar for Ice Sheet Measurements (PRISM) project with the main goal of developing and testing surface-operated radars to measure ice thickness and determine bedrock conditions in Antarctica and Greenland. The system was fine-tuned in the field to a center frequency of 150 MHz with a bandwidth of 20 MHz to produce greater sensitivity, thus achieving a resolution of 8.45 m. The survey covered a 30 km by 8 km area with 1-km line spacing along a polar stereographic grid that overlapped both the drill site and the WAIS divide.

The surface based radar had eight receive antenna elements in a linear array as well as two transmit antennas. Synthetic Aperture Radar (SAR) processing was done to increase the SNR and enhance the basal returns and bring out some of the deeper layers. With the higher SNR the basal returns are nearly continuous and therefore the ice thickness was able to be estimated and a digital elevation map (DEM) of the base of the ice sheet was created.

Major findings to date:

1) Nearly continuous internal layers are observed as deep as 2800 m, as much as 500 m below the deepest previously mapped layers in this region.
2) Internal layers have been detected to within 350 m of the bed, covering about 90% of the ice thickness.
3) Ice thickness varies between 3100 m and 3550 m over the grid and is about 3500 m at the drill site.
4) Basal returns are nearly continuous along gridlines and vary by more than 30 dB, indicating both wet (slippery) and frozen bed conditions.

The data will aid rigorous interpretations of the WAIS Divide ice core (impurity records and depth/age scale) and the morphology and evolution of the region (mean annual accumulation rates, spatial extent, divide migration and volcanism). Fine-resolution information on deep internal layers, ice thickness/bed elevation and basal conditions will help unlock glacial, climate change and sea-level histories by constraining both forward and inverse two and three dimensional dynamic ice flow models. Echograms, ice thickness, bed elevation maps and the processed data are available on the CReSIS website:
https://www.cresis.ku.edu/research/data/antarctic_data.html