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Analysis of common-midpoint radar surveys in West Antarctica and Northeast Greenland

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We use low-frequency (∼3-5 MHz) common-midpoint (CMP) radio-echo sounding surveys conducted during the 2011-2012 Antarctic and 2012 Greenland field season to determine the englacial attenuation rate as a function depth for Whillans Ice Stream and the Northeast Greenland Ice Stream, respectively. The results of the CMP analysis are compared to attenuation rates estimated using a common offset profile. After validation of attenuation results, we also attempt to derive a temperature profile of the ice column. Our experiments are of interest for two reasons: 1) proper knowledge of englacial attenuation is necessary to interpret bed reflection amplitude as an indicator of the dielectric properties of the ice-bed interface (MacGregor et al. 2007), and 2) ice temperature, and thus also the ice rheology, is an important factor for understanding ice sheet flow in ice sheet models (Khazendar et al. 2007). Although other techniques can also be used to diagnose basal conditions, ice temperature is only measured in boreholes, usually as part of an ice core drilling project. As a result, a precise, spatially expansive knowledge of the thermal state of the ice sheet is lacking. These borehole measurements are costly and time consuming, making a robust geophysical method for ascertaining ice temperature increasingly attractive. If this method proves successful, it will provide a fast, low-cost means of collecting ice temperature data across wide areas of ice sheets.

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