An Englacial Radar Attenuation Modeling Approach and Application to the Ross Ice Shelf, Antarctica

[1]J. Millstein, [2]W. Chu, [2]I. Das, [2]R. Bell

[1]Dartmouth College, [2]Lamont-Doherty Earth Observatory of Columbia University

Over the Ross Ice Shelf, recent studies have indicated extensive and widespread thinning of the ice shelf presumably with a significant contribution from bottom melting. ROSETTA-ICE, an NSF sponsored multi-university airborne geophysical campaign, was designed to study the Ross Ice Shelf using a suite of instruments including ice penetrating radars, laser altimetry and gravimeter, and provide an integrated understanding of the processes that can impact the stability of the Ross Ice Shelf. In this study, we present techniques used to derive basal reflectivity of the ice-water interface in the Ross Ice Shelf. This work is the first comprehensive mapping of basal reflectivity of the Ross Ice Shelf at a 10 km line spacing. Using airborne radar data from the ROSETTA-ICE campaign's 2015 field season, we developed a cohesive map of basal reflectivity by correcting for dielectric attenuation through the ice and geometric losses. Radar derived raw reflectivity values are corrected using a relationship between primary and multiple bed echo intensities to estimate and model depth-averaged attenuation rates across the entire ice shelf. The resulting depth-averaged attenuation rates and correction for basal reflectivity show that this method of linear fitting is a viable means to uniformly correct for geometric losses and dielectric attenuation over a large area. Our reflectivity maps clearly show the flow features and point out stark reflectivity differences between ice flowing from East and West Antarctic glaciers, indicative of a difference in basal melting processes on either side of the ice shelf. We also compare our results with other existing results of basal reflectivity in the region. This reflectivity map will be used to provide evidence of where the ice shelf could be melting or freezing from the bottom and will be used for mass balance estimates of the ice shelf.