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Student Research Conference – Abstract

In July 2012, 200 km of 400 MHz ground-penetrating radar (GPR) profiles were collected across the Juneau Icefield, Alaska. The goal was to determine if spatial accumulation rate variability and winter mass balance estimates could be improved by linking stratigraphic features between yearly-excavated snow pits through GPR. Profiles were collected along the centerline and cross sections of the main branch, northwest, and Southwest branch of the Taku Glacier as well as the Mathes, Llewellyn, and Demorest Glaciers. Over 650 km^2 of area and 1000 m of elevation range were covered during this pilot project linking sixteen snow pits with GPR data across the icefield. The field work was conducted as part of the Juneau Icefield Research Program (JIRP) with hopes of continuing this method in future years if first year results show promise. As an annually operated field research and education program, JIRP creates a unique opportunity to provide significant future contributions to Alaska mass balance records if the program is continued. Signal penetration reached approximately 25 m with maximum depths reached at higher elevations of the icefield. Conversely, minimal penetration occurred in wetter regions at lower elevations, likely caused by volume scattering from free water within the firn and ice. Ice lenses and the annual layer located in mass balance snow pits correlated well with continuous stratigraphy imaged in GPR profiles suggesting that the lenses are relatively uninterrupted across the icefield and that GPR may be an appropriate tool for extrapolating point mass balance pit depths in this part of Alaska. The Northwest and Southwest Branches of the Taku Glacier show a strong stratigraphic thinning gradient, west to east; the main trunk of the Taku Glacier which originates from the Mathes-Llewellyn ice divide showed a similar thinning from the divide to the ELA. The thinning displayed by all three glacier systems matches a typical gradient from accumulation zone to ELA. However, it is also likely that a local influx of accumulation at the higher elevations of the Southwest and Northwest Branches result from their close proximity of the ocean. Beyond mass balance estimates, radar profiles also revealed ablation horizons underlying the annual layer near the ELA. Monitoring the location of this ablation horizon relative to the annual balance reflector may be helpful in quantifying changes in the ELA at the end of each previous melt season. Perched water tables were also imaged in several locations which may be suitable for future hydrological studies focused on delineation of sub-glacial drainage systems and their impact on local glacier dynamics. This is a particularly interesting finding considering the unprecedented recent jokulhlaup of the Mendenhall Glacier and re-routing of the primary water drainage at the Llewellyn Glacier terminus in 2011.