



Helicopter-borne snow profiling on alpine glaciers with GPR

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The spatial distribution of snow accumulation plays an essential role for the mass balance distribution on alpine glaciers. Traditional point measurements (snow pits and -probes) are labour intensive and interpolation in-between the points causes uncertainties. Airborne radar measurements have already been used for snow mapping in non-glacierized terrain, but not on Alpine glaciers. To enhance our understanding of the spatial distribution of accumulation and pin down reasons for observed variations, we have conducted high-resolution helicopter-borne radar measurements on the temperated glacier Findel and neighbouring Adler Glacier in southwestern Switzerland. The radar sensor was mounted underneath a helicopter and operated at a centre frequency of 500 MHz with a bandwidth of 400 MHz. The results were validated with extensive ground-based profiling of the snow cover. The radar data allows a clear recognition of the snow cover (6% of the total profile length of 10 km did not allow interpretation due to missing or disturbed layering) and agreed well with the ground based measurements ($R_2 = 0.85$). Reduced accumulation has been observed in all crevassed zones. Statistical analysis of the correlation between observed accumulation and terrain characteristics have been performed in a GIS environment, revealing differing accumulation patterns: On the lower part of Findel Glacier accumulation shows a clear altitudinal trend, while the upper part is dominated by strongly varying snow depth without an altitudinal trend. The accumulation characteristic on Adler Glacier is similar to the upper part of Findel Glacier, but despite of their close vicinity, accumulation is reduced by 40% compared to the same elevation on Findel Glacier. This study reveals a large potential of helicopter-borne snow profiling for measurements of accumulation distribution on alpine glaciers.