



Ice thickness and snow accumulation radar measurements at Union Glacier, West Antarctica

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Two different types of radars were designed and built at Centro de Estudios Científicos (CECS), in order to measure the total ice thickness and surface snow accumulation of Antarctic cold ice. The first tests were done on the ground at Union Glacier, West Antarctica in December 2010, with the support of the private company Antarctic Logistics and Expeditions (ALE). Several profiles were obtained totalizing more than 300 km of surveys. A FMCW radar was developed to measure snow accumulation and the internal layer of the ice at high resolution. This radar operates at frequencies from 550 MHz to 900 MHz, and is using two separated log periodic antennae for the transmitter and receiver. The free-space resolution was 40 cm, the transmit power was 21 dBm, the intermediate frequency (IF) amplifier gain was 70 dB and the whole system operated at 10 kHz of PRF. Direct Digital Synthesis (DDS) system was used to generate a extremely linear frequency sweep transmitted signal. A maximum snow accumulation of 70 m was found in Union Glacier, and the blue ice-snow layers boundary was clearly mapped down to 20 m. The second system is a pulse compression radar for ice thickness measurements. This system operates at a central frequency of 150 MHz, with a bandwidth of 20 MHz, 400 W of peak power and 10 kHz of PRF. With this bandwidth, the range resolution was 4.2 m in ice. The receiver gain was 90 dB. High gain Yagi antennae were used for both the transmitter and receiver. Several profiles were surveyed, including a traverse of 80 km along Union, Schanz, Schneider and Balish Glaciers, West Antarctica, where a maximum ice thickness of 1800 m was detected. The main aim of these measurements was mapping the subglacial topography of a poorly know area, where Union glacier is located. The blue ice area of this glacier has been transformed into the main hub for airborne and on the ground explorations of inner west Antarctica, thanks to the local blue ice runway operated by ALE, where airplanes are landing on wheels. The collected data allowed to determine the main glaciological characteristics of the glaciers. The collected data also validated both radars, for their future installation onboard airborne platform for long range glaciological surveys in Antarctica.