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Spatiotemporal variations of snow accumulation over western Elbrus plateau (5100 m asl), Central Caucasus from high frequency radar measurements

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Cold glaciers in mid-latitude can be considered as unique achieves of environment and climate. However, alpine ice cores are difficult to interpret as dynamic changes can occur over a very short distances (glacier thickness, surface and bedrock topography, firn/ice transition depth and net snow accumulation rate). In order to account for upstream effects on isotopic and chemical ice core records a detailed ground penetrating radar (GPR) survey can be used.

Here we present a GPR study on a western Elbrus plateau (Central Caucasus) situated at elevation 5100 - 5150 m a.s.l. This drilling site represents one of the most valuable paleo archives as revealed by deep ice core drilling in 2009 and next drilling is planned for 2018.

High-frequency ground based radar survey was performed in 2017 to assess spatiotemporal variations of snow accumulation over western Elbrus plateau. For this purpose, ZOND 12-e GPR (Radar Systems, Inc.) with 500 and 300 MHz shielded antennas was used. The GPR control unit and the Gamin GPS receiver were mounted on special adjustable platform while antennas were pulled by operator. During two working days about 17.5 km of radar profiles (more than 100 thousand measurement points) with both antennas were performed. The receiving time window was set to 100 ns (500 MHz antenna) and to 470 ns (300 MHz) in order to image a depth ranges of about 10 m and 50 m respectively. GPR results were verified with shallow (24 m) ice core stratigraphy, density and chemical composition records. Density profile revealed peaks and corresponding 1-2 cm thick ice crusts that formed during the summer periods. Powerful extended reflections on the radargrams were interpreted as boundaries of the annual layers. A detailed snow accumulation distribution map was obtained. The average thickness of seasonal snow cover on the investigated part of the plateau was 4.1 m, with minimum and maximum values of 1.6 and 7.4 m respectively.

Internal reflections which were clearly seen on 300 MHz profiles down to 50 m depth are of isochronic origin. They provide useful statigraphic information permit the transfer of age–depth relations within the plateau. The obtained data will be used as a basis for depth age modelling and choosing the best location for future deep ice core drilling.

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