RADIO-ECHO SOUNDING OF MOUNTAIN GLACIERS

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Abstract. Experiments on radio-echo sounding of mountain glaciers have been done on Lednik Marukh (west Caucasus), Lednik Bezingy and Lednik Dzhankuat (central Caucasus), Lednik Gergety (east Caucasus), and Lednik IGAN (Polar Urals) in 1967–71 as a part of the I.H.D. programme. Radio altimeters operating at a frequency of 440 MHz with a pulse duration 0.5 μs and with an assumed radio-echo system performance of 130 dB were used. The apparatus was operated from the ice surface (using sledge or vehicle) and partly from a helicopter. Some measurements have been made while the apparatus was being moved continuously along longitudal and transverse profiles of the glacier. Some of the measurements have been made at separate points on the glacier. The methods of measurement and interpretation have been worked out. Data on ice thickness, subglacial topography, and internal structure of some mountain glaciers have been obtained and compared with data got using other geophysical methods and thermal drilling. There is agreement between the results.

STATISTICAL METHOD OF RADIO-ECHO SOUNDING TEMPERATE MOUNTAIN GLACIERS AND PORTABLE EQUIPMENT FOR THAT

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Abstract. Field experimental data show the possibility of using standard radio-echo sounding equipment of relatively low power to sound through a temperate mountain glacier. The main problem of sounding is the interpretation of echo signals, because they are a mixture of visually indiscernible echoes from the bed and from inhomogeneities in the body of the glacier. To get information about ice thickness and other things from such echo data, a method based on a statistical analysis of echo-signal fluctuations is proposed. As a main criterion the stability of echo-signal statistical characteristics is used.

Special portable equipment was designed based on this method. The equipment makes the interpretation of radio-echo sounding data simple. It eliminates distortions of echo signals because of receiver overloading by powerful impulses, automatically records the form and intensity of signals, makes its amplitudes proportional to reflection characteristics of the ice bed and inhomogeneities of the glacier body, and makes automatic statistical analysis. The thickness of a glacier, and the position of inhomogeneities within its body, are determined given more than ten radio-echo signal positions.

The method and the equipment have been used to determine thicknesses of Lednik Dzhankuat (Caucasus). Radio-echo sounding data have been compared with data obtained by other geophysical methods and thermal drilling. There is a good agreement ($\pm$10 m when the ice thickness is about 100 m).

INTERPRETATION OF RADIO-ECHO SOUNDING DATA ON A TEMPERATE MOUNTAIN GLACIER FROM ITS SURFACE

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Abstract. Temperate mountain glaciers have specific peculiarities which make the interpretation of radio-echo sounding data much more difficult than for polar ice sheets. On the A or Z indicators one can observe a plurality of pulses differing in shape, amplitude, and range. Often a gap is observed on the film. The problem is to select the pulses from the bed or internal reflecting horizon and to reconstruct the subglacial relief or internal interface.

During preliminary processing, the radio-coordinates of all marks on a type A radiogram are written into a table. Then non-informative marks are eliminated and informative marks are situated on a continuous line or trace.

We put into practice three methods of interpretation: (1) an envelope method, (2) Harrison's transformation method, (3) approximation of segments of a trace by straight lines. Harrison's transformation method is the most general one; the others are useful for the presentation of results in a graphical form. The suggested methods are used for the interpretation of the data from a transverse profile of the valley glacier Lednik Bezengiy, Caucasus, 1970–71. Radar RW-10 with a carrier frequency of 440 MHz and overall receiver sensitivity relative to the transmitter pulse power 130 dB was used. It was revealed that the transparency of the glacier changes from year to year. The maximum ice thickness measured was 330$\pm$15 m. Some extended interfaces in the body of the glacier were discovered. One of them, 80 m deep, coincides with seismic contrast interface and with the 0° C isotherm. Radio-echo sounding data are in agreement with gravity measurements on the same profile.