GC2024-SG064

Experiments on the use of seismic and infrasound methods for remote recording of snow avalanches

Ivan S. Fedorov[1] , Andrey V. Fedorov[1] , Vladimir E. Asming[1]

[1] Kola Branch of Geophysical Survey, Russian Academy of Sciences, Russia

ifedorov@krsc.ru

Avalanches are a dangerous natural phenomenon that occur in mountainous regions. Every year, hundreds of people are caught in avalanches, and these incidents often result in tragedy. As mountain tourism and extreme winter sports become more popular, the number of avalanche accidents is on the rise. Visual observation of slopes remains the primary method of avalanche detection. As a result, the collection of avalanche observations, particularly in isolated mountainous regions, is still incomplete. Similar to earthquake forecasting, predicting avalanches is a complicated task that requires a comprehensive dataset of avalanche and meteorological observations. To begin this process, a remote, all-weather automated monitoring system for avalanches should be established. The Kola Branch of the GS RAS has initiated the development of a hardware and software complex for avalanche monitoring. The complex will be based on the registration of seismic and infrasound signals. Over the last five years, a series of experiments were conducted in the Khibiny mountain massif to support this initiative. The experiments focused on the registration of avalanches initiated within the framework of avalanche safety services. During the experiments, signals caused by avalanches were recorded using a broadband seismometer and an array of three low-frequency microphones installed at varying distances from the avalanche source. The results demonstrate the high registration abilities of the infrasound method, while also revealing the challenges associated with using the seismic method to solve these problems. The technical solutions have been developed [1], and prototypes of software for automated detection of target signals have been created [2].

Consequently, an experimental complex for monitoring avalanche activity in the Khibiny mountain massif was established. The operation of the complex demonstrated that infrasound signals generated by the movement of snow mass on the mountain slope can detect avalanches with a volume of about 5 thousand cubic meters at a distance of 7 km. The smallest avalanche on record had a volume of 0.5 thousand cubic meters and was located 2.5 km away from the station.

Fedorov A.V., Fedorov I.S., Voronin A.I., Asming V.E. Mobile infrasound avalanche monitoring system: general design principle and application of results // Seismic Instruments. – 2021. – V. 57, N 4. – P. 369-375. DOI: 10.3103/S0747923921040058

Asming V.E., Fedorov A.V., Vinogradov Yu.A., Chebrov D.V., Baranov S.V., Fedorov I.S. Fast infrasonic event detector and its application // Geophysical Research. – 2021. – V. 22, N 1. – P. 54-67. DOI: 10.21455/GR2021.1-4