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Full-Scale Testing of the Use of Distributed Acoustic Sensing (DAS) Technology to Determine Ice Cover Parameters

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This paper presents preliminary results of an experiment conducted in the ice-covered waters of the Klyazma Reservoir in February 2024. The purpose of the experiment was to study the possibility of using a distributed acoustic sensor (DAS) to record seismoacoustic signals arising in a floating ice sheet.

It is known that the study of dispersive waves propagating in a layer of ice makes it possible to restore the characteristics of the ice cover [1]. Continuous recording of seismoacoustic waves in ice by two or more sensors makes it possible to implement a scheme for monitoring ice parameters (thickness, elastic properties) along fairly long routes.

This task is especially relevant in connection with the ongoing warming processes in the Arctic, which leads to the need to assess the degree of ice cover of the Northern Sea Route. In addition, the solution to this problem may be in demand, for example, for organizing winter ice crossings.

During the experiment, preliminary results were obtained that showed the possibility of using DAS to record seismoacoustic signals in an ice sheet. Further research in this area may lead to the development of new methods for monitoring ice parameters and optimizing the process of organizing ice crossings.

The use of DAS in ice conditions represents a scientific novelty [2]. The fact is that the sensor, formed from a straight fiber-optic cable laid along the ice surface, is sensitive only to deformations along the cable line. In this case, the most informative from the point of view of ice characteristics is precisely the vertical component of the vibrations of the ice plate, which is effectively measured, for example, by a geophone, but is not recorded by such a fiber-optic line.

To solve this problem, a unique scheme for laying a fiber-optic cable was used with the formation of mutually perpendicular rings, which make it possible to measure fiber deformations both along the linear group and across.

As a result of the study, a comparative analysis of DAS measurements on ice was performed with a reference instrument, which used a linear group of 24 vertical geophones, the distance between which was 5 meters.

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Reference

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[2] *Coutant O. et al.* EGU General Assembly Conference Abstracts. 2021. C. EGU21-7404.