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Temporary seismic network on drifting ice in the North Barents Sea

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Despite the strong attention to the investigations in the Arctic its advance quite slowly. The harsh climatic conditions and big expenses slow down realization of the fieldwork in high latitudes. Therefore, scientists from over the world looks for new technologies, which could optimize and reduce the costs of the fieldworks that aimed at investigation of the geological structure beneath the Arctic Ocean. From March to May 2019 scientific expedition on the Expedition Vessel “Akademic Tryoshnikov” operated by the Arctic and Antarctic Research Institute that belongs to Rosgidromet were conducted in the framework of the program “TransArctica 2019” first stage. In the framework of the seismological experiments 6 temporary seismic stations at 4 different locations were installed on a drifted ice floe in the North Barents Sea. The first aim of the experiment was to elaborate technology of installation of the seismic stations on the drifting ice floes. The second aim was to check if obtained seismological records could be used for registration of the local and remote earthquakes, which are meant to investigate the lithosphere structure in the Arctic regions, and for investigation of the processes within the ice floe.

The stations were installed in the April 2019 on the ice floe near the EV “Akademik Tryoshnikov” that were “frizzed” in the ice floe and drifted together with them. After analysis of the recoded data the following types of the seismic signal generated by processes in the ice were observed:

- - background signal from bending-gravitational waves with periods from 1 to 30 sec. Swell waves with periods from 17 to 30 sec were observed permanently during the whole period of network operation;
- - continuous mechanical vibrations (self-oscillations) with a period of up to 2-3 sec;
- - stick-slip relaxation self-oscillations with a period from 0.1 s to several minutes;
- - mechanical movements of ice due to compression or stretching of ice caused by chaotic different scales fluctuations in the drift velocity of ice floes;
- - process of ice fracturing due to compression or stretching of ice.

Results of monitoring of the ice cover has shown that in the most cases there are no direct correlations of processes within the ice floes and local hydrometeorological condition. During the process of ice cover fracturing an increased value of the ice horizontal movement were observed.

Analysis of the seismic signal from ice events has shown that stick-slip events preceded origin of the ice fractures.

As a result of the initial analysis of the seismograms several signals from remote and regional earthquakes were detected. For example, an earthquake that according to the ISC bulletin occur at 08:18:23UTC on April 11, 2019 near the Japan (40.35°N, 143.35°E, 35 km depth, MS = 6.0) were detected. A local earthquake that occur approximately at 05:58UTC on April 10, 2019 at a distance of ~500 km. Due to close location of stations to each other the localization of the earthquake is impossible.

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