Geophysical surveys on the outburst of Progress Lake (Larsemann Hills, East Antarctica) in the field season of the 64th Russian Antarctic Expedition

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The Russian Antarctic Progress Station (Larsemann Hills, East Antarctica) is considered as key infrastructural facilities of the Russian Antarctic Expedition (RAE) that provides the operation of Vostok Station. Intensive logistic operations require special attention to the necessity of checking the safety of routes, which are used during the summer season for heavy vehicle transportation. Lakes of this area are characterized by annual catastrophic outburst floods, which have destructive power and can cause significant damage to people, machinery and transportation networks. For instance, during 62nd RAE field season after the outburst of the Boulder Lake, the depression with the size of 183 x 220 m and 43 m in deep was formed in its western part. It destroyed the active sector of the route, which connects Progress Station with the airfield and the point of formation of logistic traverse to the interior of Antarctica. This example indicates the importance of periodical monitoring of the status of outburst lakes located near the station infrastructure objects from the point of view of safety for transport operations. Geophysical methods are an efficient and reliable way to study such processes.

Over the years, the station staff has been observing annual outbursts of Progress Lake, which were destroying the section of the route operated during the summer period. During the field season of the 64th RAE, a complex geophysical survey using the methods of GPR and the methods of natural electric field was carried out on a snow-ice bridge that crosses the lake. Fortunately, the work had been accomplished a few hours before the outburst took place. This allowed the authors to obtain information at the time of the near-critical state of the snow dam. According to GPR data, the presence of a lake water flow was

spotted inside the dam, which was accompanied by a negative anomaly of the natural electric field potential. Presented possibility of mapping the state of dams in outburst lakes by geophysical methods is an important methodological aspect of further studying of such objects from a scientific point of view and for practical purposes.

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The dynamics of the individual avalanche risk in the Khibiny Mountains

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Khibiny Mountains are located in the center of the Kola Peninsula, North-West of Russia in the Arctic. The region of the Khibiny Mountains is unique because of the long-term and well-documented dynamics both in industrial development (started in 1929) and in avalanche hazard activity. The industry appeared in a previously almost unsettled area during a few years. The development of the region was carried out without avalanche hazard taking into the account.

While the altitude of the Khibiny Mountains is relatively low, the release zones are steep enough (35-40 deg. on average). In the Khibiny Mountains 0,8-1 avalanche release zones fall within 1 sq.km of a slope. In average, the duration of an avalanche activity period in the Khibiny Mountains is 240 days. Avalanches endanger mining and touristic infrastructure, roads and settlements, locals and numerous tourists. Most victims during the last years are off-piste winter sport participants (skiers and snowmobile drivers) who trigger the fatal avalanche themselves.

While some old mines with the entire corresponding infrastructure are abandoned, new mines in other locations appear. Simultaneously, the constant growth of winter sports and tourism is taking place in the region. Due to these changes the dynamics assessment of the avalanche risk in the region is critically important.

Avalanche risk assessment has been conducted in the Khibiny mountains for 2008 and 2018 years on the scale of 1: 200 000. Full social (collective) and individual risk was assessed. Full social risk shows the annual number of fatalities as the result of an avalanche impact. Individual avalanche risk is the probability of fatal accident led to the death of an individual from some group of people within the investigated territory for the period of one year. To evaluate the avalanche risk changes during the last 10 years, a technique based on a combination of social and natural indicators assessment was applied.