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Solving the puzzles from Cryosphere

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The CALM site was placed on a flat, smooth peatland with an area of 5.5 hectares (130 × 350 m), near the geocryological borehole. The peatland is located within old drained lake ("khasyrey"). The peatland and the bottom of the "khasyrey" is well expressed in the relief. The excess of the surface of the peatland over the bottom is 2.0-2.5 m. The CALM grid size is 100×100 m. Distance between measuring points of active layer is 10 m.

Vegetation cover by dominant species divides into five types of plants community.

1. Lichens and dwarf shrubs such as wild rosemary prevails in the central smoothest part of the peatland. The number of measuring points of the active layer was 45.

2. Dwarf birch ("ernik") grows on the edge of the north, east and south-east sloping surface of the platform. The number of measuring points of the active layer was 41.

3. The transient type of vegetation cover between (1) and (2) sporadically revealed on a slope surfaces. The number of measuring points of the active layer was 23.

4. Carex, cottongrass and sphagnum moss with rare lichen community revealed on a flat surface with reduced microrelief. Measurements of the active layer were carried out in 13 points.

5. Sphagnum mosses prevail on a small area on the northeast side of the platform. The active layer was measured in 3 points.

The depth of the active layer was measured totally at 121 point. The average depth of the active layer is 47 cm. The active layer in 89 points less than or equal to 50 cm, in 28 points – 70 cm, more than 70 cm – 4 points.

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Comparison of temperature data in boreholes at the Parisento field station (august 1986 - august 2018)

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The territory of the Gydan Peninsula is one of the less developed and underexplored areas. To implement plans of environmentally safe commercial development of Tazovsky District in Yamalo-Nenets Autonomous Okrug, one requires an assessment of a current state of the Gydan Peninsula cryolithozone and monitoring of the cryolithozone conversion under the influence of climatic changes and human-induced load in all terrestrial subsystems of the peninsula. This will make it possible to improve design techniques of field facilities and hydrocarbons transportation systems placed in complex engineering geocryological conditions to ensure their mechanical safety and reduce geotechnical risks through increasing design performance as related to the development of activities on implementing technologies of temperature stabilization of bottom soils, geotechnical monitoring, and other advanced technologies.

One of key tools for monitoring the cryolithozone conditions and evolution is the borehole temperature field determination. In the 80s of the past century, there was an entire network of profiles to observe thermometric boreholes at the Parisento field station. However, several decades on, being abandoned, boreholes became useless. Arctic Research Center of Yamalo-Nenets Autonomous Okrug was given a task to reinitiate investigations at the field station and to locate new boreholes near the existed ones in the past for comparing earlier temperature values with the current ones and continuing the monitoring.

Locations for boreholes placement were planned in areas with different geomorphic conditions typical for this region. Drilling operations were carried out via mobile boring machine UKB 12/25I applying a combined method of core and auger drilling. The screw diameter was 62 millimeters; the boring bit width was 70 millimeters; the spoon bits' widths were 108 millimeters and 60 millimeters correspondingly. Upon passing the permafrost line by the spoon bit of maximum diameter, a temporary surface casing, i.e., an iron tube with a diameter of 108 millimeters, that protected the borehole against meltwater during drilling, was installed in the borehole. Further drilling was made by a tool with a smaller diameter. Upon achieving the target depth, the borehole was lined with a one-piece metal-reinforced plastic pipe with a diameter of 32 millimeters and a wall thickness of 3 millimeters. 6 boreholes 10 meters dip were placed in total.

To compare temperatures with the received earlier data properly, at least one-year monitoring is needed. However, even now, we can compare the first data received in August 2018 with data known upon reports of All-Russian Institute of Hydrogeology and Engineering Geology from August 1986. For instance, the temperature increased by 2.5-3 degrees in two boreholes at a depth of 10 meters, which is close to the depth of zero-point annual variations. Monthly data of other boreholes aren't at our disposal, so we didn't get a chance to compare them.

Summarizing, permafrost temperature monitoring was renewed at the Parisento field station. According to the first received data, one can say that the permafrost temperature is rising. Continuing the monitoring will help in answering the questions about the further evolution of cryolithozone.

Coastal dynamics of the Kolguev Island

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Kolguev Island is the most western point in the Russian Arctic with tabular ground ice occurrence. Since the Barents Sea is characterized by strong sea ice decline, it is very interesting to study coastal dynamics in conjunction with cryogenic processes in this region. Ice exposures on coastal bluffs favor the activation of thermal abrasion and thermal denudation. Headwall retreat of retrogressive thaw slumps causes not only thermocirque formation, but also leads to increasing coastal destruction rates. This study on Kolguev Island continues and expands our earlier research efforts on coastal dynamics in the region.

As a result of field and remote sensing data analysis, coastline classification and segmentation were done according to the morphodynamics principle. The following types are defined: 1) thermo-abrasion wave exposed cliffs, 2) abrasion (thermo-abrasion) with stabilized cliffs, bordered by beaches or accumulative terraces, 3) sheltered abrasion (thermo-abrasion) cliffs, 4) accumulating coasts and accumulative forms, 5) accumulated coasts with sheltered tidal flats, 6) deltas. Thermo-abrasion cliff coasts are predominantly distributed in the west, north and northeast of the island, and accumulative shores in the south, southeast and east of the island.

New data on thermal denudation and thermal abrasion rates for Kolguev Island have been obtained using a whole set of multi-temporal satellite images