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Monitoring of thermal regime of permafrost in the coastal zone of Western Yamal

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Data on thermal regime of permafrost are required for estimation of the climate change influence on permafrost dynamics. Monitoring of thermal regime of permafrost was arranged in the area of weather station “Marre-Sale”, western Yamal.

In terms of geomorphology, the area of our observations belongs to the second and third marine terraces; the surface of these terraces has been partly modified by recent cryogenic processes. The elevation varies from 10 to 30 m a.s.l. Marine clays lie at the base of the geological section of the coastal deposits. Their upper part was eroded and uneven surface of marine sediments is overlain by continental sandy sediments. Marine clays are saline.

In the southern part of study area, low accumulative islands are forming. Their heights above sea level do not exceed 0.5 meters, and during high tides their surface is covered by sea water. The sediments accumulating at these islands are saline silty clays.

Western Yamal region is located within continuous permafrost zone with thickness of 150 to 200 meters. Study of thermal regime in the on-shore zone has been performed since 1979 using the 10-12-m-deep boreholes. In 2007, five boreholes were included in the work program of the Thermal State of Permafrost (TSP) project developed as a part of IPY scientific activities. According to TSP program, temperature sensors were installed at depths 2, 3, 5, and 10 meters; measurements have been performed every six hours. In this presentation, results of our observations related to climate change are discussed. For different terrain units, increase of mean annual permafrost temperature during the last 30 years has reached 0.6 to 1.5 deg. C.

In the transit zone, monitoring of thermal regime have been performed since 2006. Sensors were installed at depths 0, 0.25, 0.6, 0.75, 1.25, 1.75, and 2.25 meters. The active layer depth here reaches 1.9 meters, thus the 2.25-m-sensor is located within permafrost. Monitoring data show the sharp increase in mean annual permafrost temperature from – 5 deg. C in the on-shore zone up to – 0.2 ÷ -1 deg. C in the transit zone. We believe that such a significant increase in mean annual temperature in the transit zone is related to the influence of snow cover, whose thicknesses reach 1.0 to 1.5 meters at the base of coastal bluff.

At low accumulative islands, contemporary permafrost aggradation occurs. Measurements in the 2.5-m-deep borehole show that mean annual temperature of recently formed permafrost is – 3.4 deg. C.