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Session 4:

Physico-chemical problems of frozen ground

PERMAFROST AGGRADATION AND METHANE PRODUCING IN LOW ACCUMULATIVE LAIDAS OF THE KARA SEA

Vasiliev A.[1,2], Streletskaya I.[3], Oblogov G.[1,2]

[1]Earth Cryosphere Institute SB RAS,
[2]Tyumen State University,
[3]Lomonosov Moscow State University

During the last decades, a problem of impact of climatic changes on the state and properties of the permafrost region is widely discussed in the literature. Most of these publications were focused on study of the permafrost degradation processes. At the same time, along with the permafrost degradation under continental conditions, the processes of permafrost aggradation have been observed in the modern deposits of the Artic seas.

Modern low accumulative laidas (i.e. tidal flats) are relatively widespread along the Kara Sea coast.

Borehole (69°36`, N 66°49` E) was drilled in 2007 from the surface of tidal flats approximately 12 km south from the Marre-Sale weather station in the area of modern marine sedimentation. Measurements were performed for times per day by autonomy loggers HOBO Water Temp Pro v2 at depths 0.03, 0.6, 1.1, 1.6, 2.0, 2.5, and 3,0 m.

During the drilling at the tidal flats, soil samples were collected for moisture contents, grain size, salinity, chemical composition, and organic carbon content analyses. In 2013, 2014, 2015, and 2016, additional boreholes were drilled at the same point, and soil samples were collected to determine concentration and isotopic composition of methane using a "head space" method.

Detailed long-term temperature measurements in the upper permafrost of the tidal flats allowed us to determine main features of the thermal regime. Temperature distribution with depth measured at the beginning of every month indicates that the depth of zero annual amplitude of temperatures of freezing sediments was 3 to 4 m. Mean annual temperature of frozen soils at 3.5 m varied from -2.0 to -3.9 ^{o}C.

Low tidal flats are the area of active methane producing due to activity of anaerobic bacteria, which is confirmed by isotopic

composition of methane: $\delta^{13}C$ (CH_4) values vary from –64 to –79 ‰. Analysis of distribution of methane concentration with depth indicates increase in concentrations upwards from the base of the active layer (~1.8 m).

Based on distribution of methane concentration with depth, we can conclude that the soil temperature of -3.5 to -4.0 ^oC is a threshold for bacterial methane production in conditions of tidal flats of Western Yamal. Methane cannot be produced in frozen saline soils when the temperatures are below this threshold. Frozen soils contain only preserved methane which was produced before the permafrost aggradation.

The study was supported by the RSCF grant #16-17-102. The data on soil properties were obtained during the work on the RFFI project #16-05-00612.

METHANE IN FROZEN DEPOSITS OF THE WESTERN SECTOR OF THE RUSSIAN ARCTIC AS A RISK FACTOR OF NATURAL DISASTERS

Streletskaya I.[1], Vasiliev A.[2,3], Oblogov G.[2,3], Streletskiy D.[2,4]

[1]Lomonosov Moscow State University, Russia, irinastrelets@gmail.com
[2]Earth Cryosphere Institute SB RAS, Russia
[3]Tyumen State University, Russia
[4]George Washington University, Department of Geography, USA

Methane in permafrost Pleistocene and Holocene sediments of the western sector of the Russian Arctic (the coasts and shelves of the Kara and Barents Seas) is a potential factor in forecasting of natural disasters. The identify areas with potentially high risks of natural disasters related to methane emissions is actual scientific task. The solution of this problem will help to decrease the risks associated with industrial development of the Arctic Regions. The effects associated with methane emission from permafrost on global climate system and as a factor potentially increasing the risk of natural disasters are of considerable importance in recent years and bringing attention of mass media, policy makers and scientific community.

A striking example is the formation of deep craters as a result of explosive methane emissions in Yamal, Gydan and Taz Peninsula. The nature of these catastrophic phenomena is under discussion in the scientific literature. The forecast of such catastrophic events should be