International Conference

Solving the puzzles from Cryosphere

Pushchino, Russia, April 15-18, 2019

Russian Academy of Science
Institute of Physicochemical and Biological Problems in Soil Science RAS
“Okabiolab” Ltd.

International Conference
‘‘Solving the puzzles from Cryosphere’’

PROGRAM
ABSTRACTS

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The International conference «Solving the puzzles from cryosphere» organized by: Institute of Physicochemical and Biological Problems in Soil Science RAS and “Okabiolab” Ltd.

Conference Committees.

Chair of the Organizing Committe: Andrey Alekseev (Corresponding member of RAS, Director of IPCBPSS RAS)
Chairs of the Programm Committee: Vladimir Melnikov (Full member of RAS), Marat Sadurtdinov (Director ECI Tyumen Scientific Centre SB RAS), Mikhail Zhelezniak (Director MPI SB RAS), Elizaveta Rivkina (Head of Soil Cryology Laboratory, IPCBPSS RAS)
Programm Committee: Andrey Abramov, Dmitry Drozdov, Vladimir Tumskoy, Olga Makarieva, Felix Rivkin, Stanislav Kutuzov, Alexey Lupachev

Chair of the local Organizing Committee: Andrey Abramov (Soil Cryology Laboratory, IPCBPSS RAS)

Local Committee: Svetlana Chudinova, Elena Spirina, Victor Sorokovikov, Tatiana Vorobyova

Technical group: Aleksandra Veremeeva, Anastasya Shatilovich, Lyubov Pasnitskaya, Lidia Gulyaeva, Larisa Kondakova, Ekaterina Sokolova, Stanislav Malavin

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Bh. 18/3K is located 0.7 km to the north-west from the Bh 18/2K, on the watershed of the edoma (altitude of 40 meters above sea level) reveals deposits of the ice complex. Seasonally thawed layer – 1.0 m (as of 20.09.2018). The soil surface is covered by thick litter of needles of larch (4-5 cm) and foliage of shrubs in varying degrees of decomposition, as well as fragments of burnt wood are observed. The plant cover of moss-and-lichen cover reaches 90%. The mineral part in section is observed to a depth 1.6 m and is represented by gray silt, brownish-gray with fraction content of 0.05-0.01 mm - 47.7-54.7%. Sediments are characterized by low ice content, massive and thin cryostructure. Ice wedge is observed from a depth of 1.6 m to the bottom.

Studies have shown that forest fires in the considered areas of post-pyrogenic successions underlain by the ice complex did not initiate the thermokarst processes. Appearingly, ground subsidence began to develop on the surface, but inroad of water did not occur in virtue of the high drainage of the sites.

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Activation of cryogenic processes in Central Yamal as a result of climate change and thermal state of permafrost

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Abnormal weather conditions over the past few years significantly affected increase of activity of cryogenic processes associated with ground ice thawing in Central Yamal. Air temperature rise resulted in increased warm season thawing reaching the top of ground ice. Thus thermodenudation started and caused formation of thermocirques. Climate fluctuations also lead to increase of ground temperature, which triggers gas-emission crater (GEC) formation through decomposition of methane clathrates up to formation of high pressure under the tabular ground ice layer until it breaks.

The warm season thawing dynamics was studied along four grids with various surface features in the research station “Vaskiny Dachi” in Central Yamal within the framework of CALM program. All types of surface are characterized by a significant deepening of active layer in 2012 compared to the previous period 1993-2011 by 12-20%. Even larger deepening of active layer was observed in 2016 (by 24-37%). Years of 2012 and 2016 are characterized by the highest thaw index and the largest sum of summer precipitation. Thus, an increase of summer air temperature and amount of summer precipitation influenced the formation of thermocirques through warm season thawing increase.

To explain the reasons for the GEC formation, ground temperature data obtained within the framework of TSP program were analyzed. Dynamics of the measured temperature at different depths in thermometric boreholes located in different landscape and geological conditions (from sparsely vegetated sands to shrubby clay) were considered.

Analysis of climatic parameters showed that there is a warming trend over the period from 1947, the expected year of the beginning of gas release within permafrost and the growth of the mound (Arefyev et al., 2017). The mean annual air temperature increased from the beginning of the mound growth and the date of formation of GEC (66 years) by 1.7°C. The ground temperature is more influenced by winter air temperature and the sum of winter precipitation. From 1947 there is increasing trend of the winter air temperature till 2013 with the highest value in 2012. Trend of the sum of winter precipitation was not observed.

The mean annual active layer temperature tends to substantial increase in 2012 and 2016. Also, there is a significant increase of the ground temperature at 10 m depth, starting from the moment the borehole was established (the growth over 5 years is 0.5°C).

The current temperature of the permafrost near GEC-1 is from -1 to -5°C (Buldovicz et al., 2018). Measured in August 2015 ground temperature at 10 m depth in the boreholes near GEC-1, was from -4.3°C on shrubby upper part of slope to -2.7...-1.6°C on khasyrey and thermokarst lake coast, and to -1.2°C in the nearest vicinity of GEC-1 edge. An approximate calculated temperature gradient near GEC-1 is 1°C. According this the ground temperature at 70 m depth must be -0.5°C. A regression analysis was carried out to reconstruct the ground temperature in earlier periods of time in the years preceding the appearance of GEC. It was found that the mean annual ground temperature increased by approximately 0.4°C at the shrubby landscape most similar to that around GEC. It follows then that in 1947 ground temperature at a depth of 70 m was -1°C, which corresponds to our observations of the temperature at which ice lenses exist in saline clay. Most likely, ground temperature increase in the clay from -1 to -0.5°C provoked increase of unfrozen water content, provided permeability of clayey deposits to migration of gas and its accumulation under tabular ground ice.

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