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

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

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a given point in time. In the case of the formation of extensive zones of tidal dehydration and freezing belt, the model can calculate the depth distributions of permafrost new formations on intensively cooled subaerial surfaces.

The simulation results confirm that with an increase in the rate of thermal abrasion retreat of the coastline, the values of the subaqueous age and the depth of the roof of the permafrost decrease. If the retreat rate of the coastline does not change, then the distributions of subaqueous age and the depth of the roof of permafrost along the coastal traverse are linear. In the case of a time-constant coastal retreat rate, the upper boundary of the subaqueous permafrost takes a stepped shape. Sites of slow increase in the depth of thawing correspond to periods of rapid retreat of the coastline. Areas with a rapid increase in the depth of thawing correspond to episodes of relative stabilization of coastal benches. As the phase transition heat of moisture decreases, as well as with an increase in the thermal conductivity of the sediment, the spatial gradient of the depth of thawing increases. The model makes it possible to adequately describe not only the degradation of permafrost during the transition of permafrost sediment to the subaqueous regime, but also the new formation of permafrost during flooding of the surface with negative temperature sea water, as well as during the formation of vast areas of drying and freezing belts with low average temperatures. The results of modeling confirm that temporary changes in the rate of thermal abrasion destruction of the coast determine the distribution of the subaqueous age of sediment in the coastal strip and the morphology of the upper boundary of the subaqueous permafrost deposits. This study was supported by RFBR, project #18-05-60004.

Monitoring of thermocirques, their activation and growth controls, Central Yamal, Russia

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About 90 new thermodenudation features, most being relatively small retrogressive thaw slumps, and at least 20 of those big thermocirques were observed in 2013 in the central part of Yamal Peninsula within the area of 350 sq.km. Thermodenudation features appeared or re-activated in 2012-2013 after extremely warm summer, and actively grow in size since then. While ground ice close to the surface is a prerequisite for thermocirque formation, the process is triggered by warming trend and deepening of the active layer. Expansion of this

landform depends on the volume of ice and further warming. Stabilization of this landform is usually caused by either exhaustion of the ice body, or by insulating of the exposed ice by active accumulation of flowing material. The last is resulting from active thaw on the one hand and dry summer weather on the other hand. Observations in Canada show that thermocirques become stabilized within 30–50 summers after their initiation (French, 2017) while near the Kara sea coast it took about 12 years.

According to our direct observations in Central Yamal thermocirques activated in 2012 triggered by extremely warm summer of 2012, and expanded at a various rate. Six thermocirques from 1 to 25 thousand sq.m of initial area annually monitored give approximation of the expansion rates. The annual rates of thermocirque area enlargement for 7 years of monitoring since 2012 vary from 1 to 6 thousand sq.m (4 to 98% of annual growth), and depend in part on climatic features of each year. Those kept stable after 2012, activated or re-activated in even warmer 2016.

Vehicle tracks observed over some thermocirques, most likely appeared before the main event of thermocirque activation in 2012, so the role of man-made disturbances is not crucial in activating the process, but this impact could have played a role in re-activation in 2016 though the tracks look already overgrown by pioneer vegetation. Active layer depth at such disturbances is up to 30% deeper than in the natural conditions.

Other controls of thermocirque growth are: slope aspect (southern-facing slopes are retreating faster), size and position of tabular ground ice in the section (the thicker is the layer and the closer to the surface, the faster growth rate).

While the coastal thermocirques grow under the additional action of the waves, inland thermocirques may rely only on the warming trend and amount of available water to help sediment flow away from thermocirque bottom. If the summer temperature rise is not accompanied by significant atmospheric precipitation, then sediment yield and removal are slowed down by landslide bodies in the transition zone. In this case thermocirque may stabilize in a short time and re-activate due to occasional exposure of tabular ground ice at the next extreme air temperature event and possible man-made effect as was observed in summer 2016 when stabilized thermocirque reactivated.

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