Application of the geotemperature modeling to indicate the danger of geocryological processes in natural and disturbed landscapes

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The RATIC/T-MOSAiC workshop at ASSW 2021
The one of principal state projects of Institute of Environmental Geoscience is “Analysis and assessment of environmental problems in the cryolithozone of Russia due to the structure and properties of frozen grounds”.

**Geocryological Hazards**

- Change of permafrost state
  - Seasonal dynamics (regime of freezing and thawing)
    - Monthly average characteristics: seasonal freezing and thawing depth
  - Inter-annual dynamics
    - Annual average characteristics: temperature and ice content

- Permafrost processes activity
  - Human induced
    - Areas
    - Intensity
  - Natural dynamics
    - Areas
    - Intensity
The impact zones:
I - The zone which the impact of the object exceeds all natural influences (heat generating buildings and water reservoirs).
II - The influence of both man-made and natural factors affects the permafrost in this zone.
III - The zone where the natural factors and hazards are dominant.

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[Khimenkov et al., 2011]
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Thaw settlement in vicinity of working borehole

Photo
O.N.Koushnarenko
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Thaw settlement at Novaya Chara – Cheena railroad
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Frost blister, Southern Yakutia
How deep is the impact of climate change?

The geotemperature forecast for different time. Central part of Yamal Peninsula, RCP 2.6

Equilibrium curve for gas-hydrates of natural gas and methane

Temperature at the end of the year, centigrade
How match?

How fast and intensive the temperatures change at different depths?

The geotemperature forecast for different time. Central part of Yamal Peninsula, RCP 2.6
Evolution and revolution. When?
Permafrost degradation progress

Temperature, centigrade:

Depth, m

Years

Время, годы
Adaptation Levels:

National

Determination of territorial and time priorities based on the regional scale ("background") geotemperature forecast.

Regional

Compilation of a list of objects requiring the adaptation measures in priority areas.

Local

Local geotemperature forecast; determination of possible ways of adaptation; comparative analysis of the effectiveness of adaptation measures. It is based on mechanical stability estimation and the calculations of economic costs.
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