1. OBJECTIVE
To evaluate current and future thawing/freezing ground characteristics over northern Eurasia using VMDO Ground Heat Transfer Model [1] (Fig 1) driven by the Regional Climate Model (RCM) [2] (Fig 2).

2. GROUND HEAT TRANSFER MODEL (GHTM)
- One-dimensional heat transfer equation
- Slightly sloped lands in the vertical
- The vegetation and snow covers are treated as additional layers
- Thermal coefficients are prescribed
- LBC: geothermal heat flux (prescribed)
- UBC: snow depth, skin temperature from RCM output

3. CURRENT CLIMATE
The Fig.3 displays current climate distribution of the active layer depth as simulated by GHTM driven by the coarse resolution CMI3 models and by higher resolution regional climate model. One can find the higher resolution reveals more spatial details in the distribution suggesting more realistic representation of the permafrost.

4. PROJECTED CHANGES IN PERMAFROST
Fig.5 shows potential distributions of seasonal thawing/freezing depths under IPCC A2 scenario as simulated by the late 20th century, mid- and late 21st century. A simulation has been performed accounting for moderately moisturized loam. The thaw depths will likely increase by 25-50% while permafrost area will shrink. Boundaries of the intermediate zone between thawing and freezing areas are expected to migrate northwards throughout the 21st century.

5. SUMMARY
- Model simulated permafrost distribution and its temporal trends in northern Eurasia are in reasonable agreement with the late 20th century observations.
- It has been shown the trends decrease with depth.
- A simulation of permafrost change over northern Eurasia has been conducted, the most significant permafrost degradation is projected at the southern boundary of the permafrost area.
- Due to high spatial variability of permafrost characteristics there exists a need to further improve the changes in the cost regions using ensembles of high resolution regional climate models.

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References

Figure 1. Structure of the ground heat transfer model.

Figure 2. RCM domain and topography (b).

Figure 3. Spatial distributions of the active layer depth as simulated by the CMIP3 ensemble (left) and regional climate model (right) under current climate conditions.

Over most part of the region RCM simulated thaw depth appears to be 30-50% larger than that simulated by the CMIP3 models. On the other hand, the area with thaw depth lesser than 0.5 m is considerably smaller as compared to that derived from CMIP3 simulations.

The permafrost boundaries in Fig. 3 are in reasonable agreement with observational estimates[5].

The changes indicate at development of warm layers between relic permafrost and seasonally frozen ground. For some ground types the permafrost can departs completely. In case it is still present, its temperature will increase significantly. The temperature increase in the deep layers could make noticeable their change in the thawing depths. Fig. 6 shows simulated changes in the temperature of the different layers. For the East Siberian transect the warming (2.5-3.5 deg C), being very extensive at the surface, reduces significantly at 1.6 m level and appears to be negligible at 10 m depth. Thus, most typical temperature changes at 10 and 1.6 m depth in the area are estimated to be within the range 1.5-2.5 deg C.

Figure 4. Linear trends in the annual mean ground temperature (deg C/decade) in different layers: (a) – author, (b1) – IAMTB, (b2) – ERCM.

Figure 5. Distributions of seasonal thawing (1) and freezing (2) depths in the late 20th (a), mid-21st (b) and the late 21st (c) centuries.