

## THERMAL STATE OF PERMAFROST IN THE NORTHERN YAKUTIA: MODERN DYNAMICS AND SPATIAL VARIABILITY.

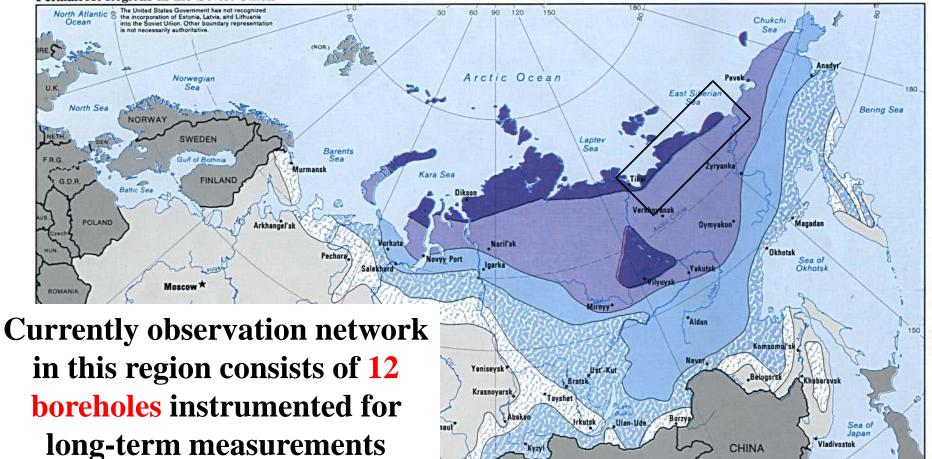
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- (4) Woods Hole Research Center, Falmouth, USA



### **REGIONAL PERMAFROST CONDITIONS (YAKUTIA)**

#### Permafrost Regions in the Soviet Union



MONGOLIA

Sporadic permafrost: maximum thickness: 25 meters

Continuous permafrost; prevailing thickness: more than 500 meters

BOO Miles

Continuous permafrost; prevailing thickness: 300-500 meters Continuous permafrost; prevailing thickness: 100-300 meters Discontinuous permafrost; maximum thickness: 100 meters KORE

East China Sea

located at the 10 sites. Continuous temperature record covering 4 and more years available for 6 boreholes.



#### **VEGETATION AND LANDSCAPE TYPES**

#### TUNDRA

#### BOREAL FOREST

FLOODPLAIN













# AN ANNUAL AIR TEMPERATURE DYNAMICS AND ESTIMATION OF THE SNOW INFLUENCE ON THE GROUND TEMPERATURE.

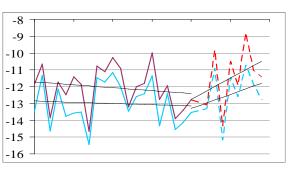
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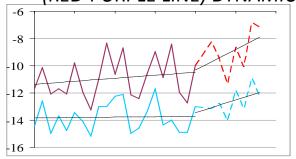
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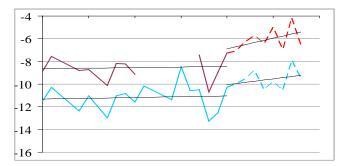
CHOKURDAH

CHERSKY

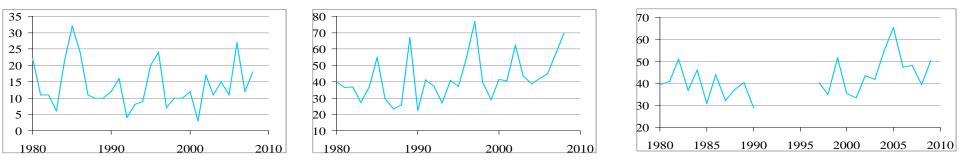
MEAN ANNUAL AIR TEMPERATURE (BLUE LINE) AND TEMPERATURE WITH SNOW INFLUENCE CORRECTION (RED-PURPLE LINE) DYNAMICS







MAXIMAL SNOW THICKNESS DYNAMICS



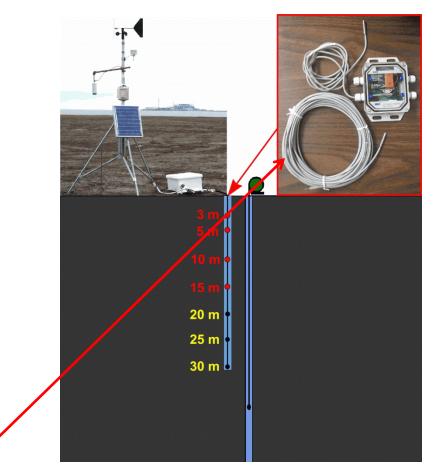
Snow warming influence was estimated using Kudryavtcev approach, taking into consideration snow thickness, density and amplitude of air temperature seasonal oscillation.



#### **METHODS - MEASUREMENTS STRATEGY**

Before 2006

Occasional or periodical measurements



After 2006

Long-term high-frequency (hourly to daily) continuous observations

Data logger HOBO U-12 with termistors TMC-HD. It allows to do measurements with resolution 0.004°C and accuracy 0.02°C

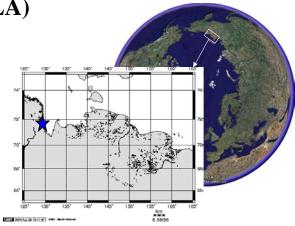




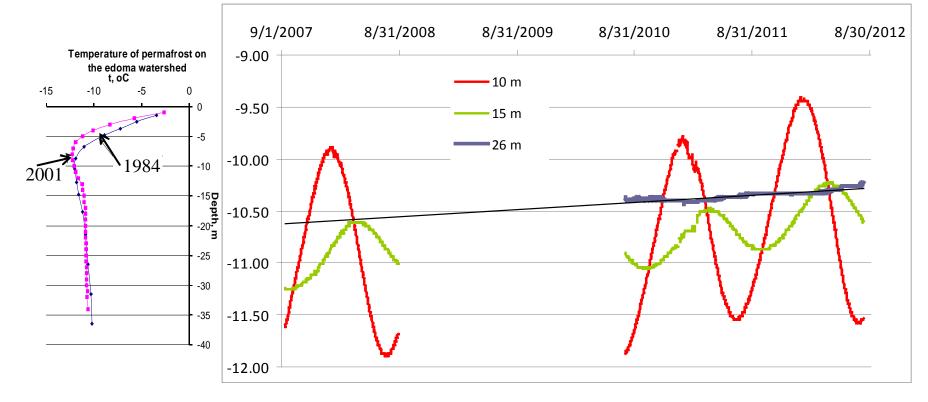
#### TUNDRA (BYKOVSKY PENINSULA)







#### MAGT at the 26 m depth (2012) -10.3°C Positive trend, °C/year 0.073

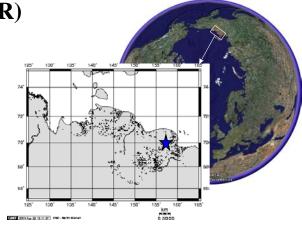




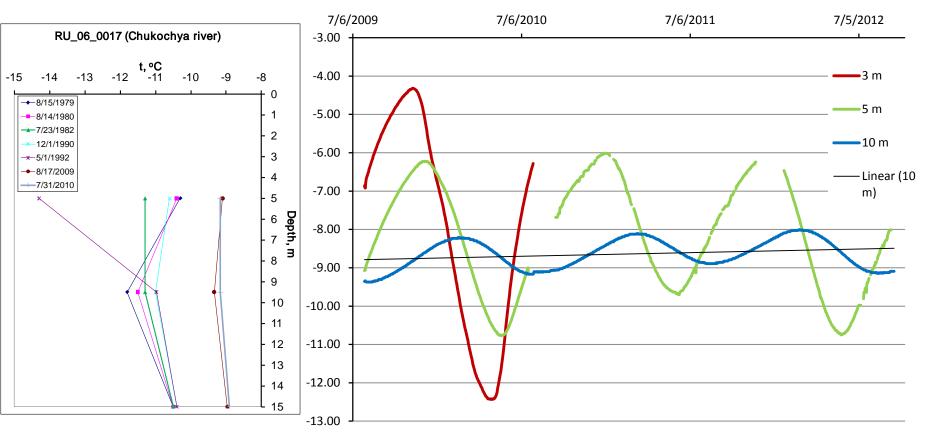
#### TUNDRA (CHUKOCHYA RIVER)





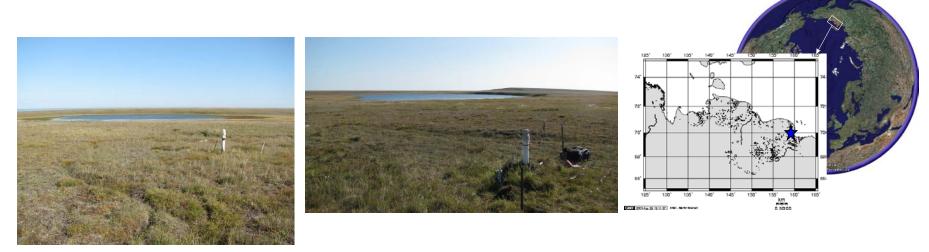


#### MAGT at the 10 m depth (2012) -8.6°C Positive trend, °C/year 0.109

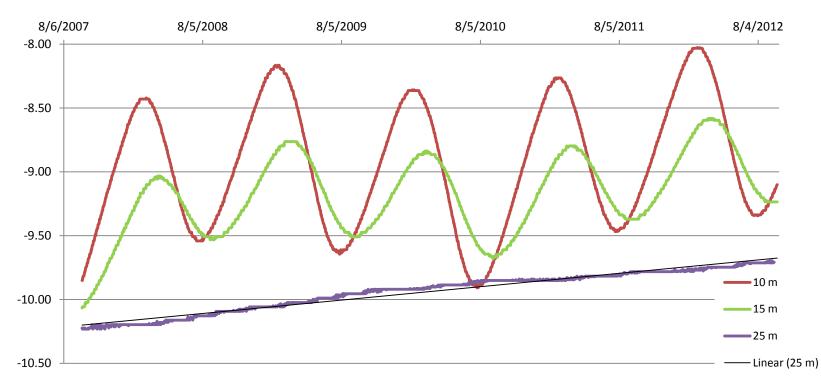




#### TUNDRA (CHUKOCHIYA CAPE)



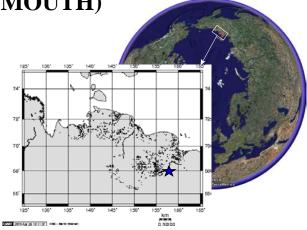
MAGT at the 25 m depth (2012) -9.8°C Positive trend, °C/year 0.109



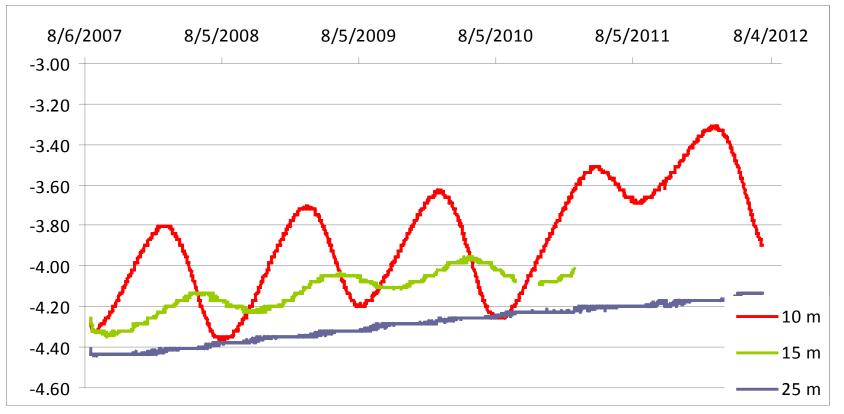


#### **BOREAL FOREST (OMOLON RIVER MOUTH)**





MAGT at the 25 m depth (2012) -4.2°C Positive trend, °C/year 0.063

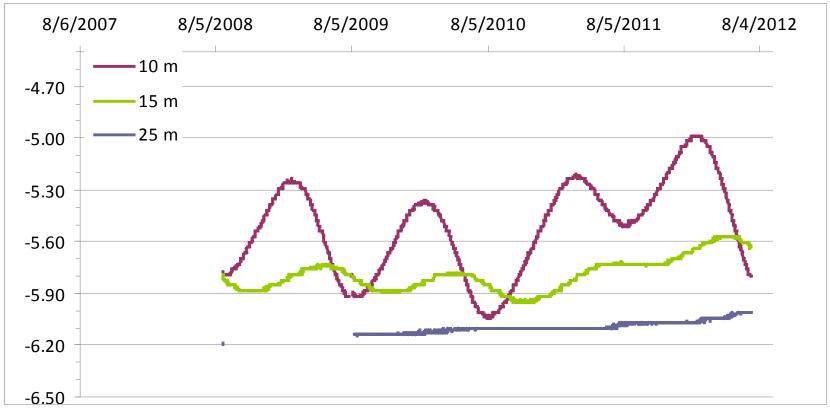




#### **BOREAL FOREST (DUVANNY YAR)**

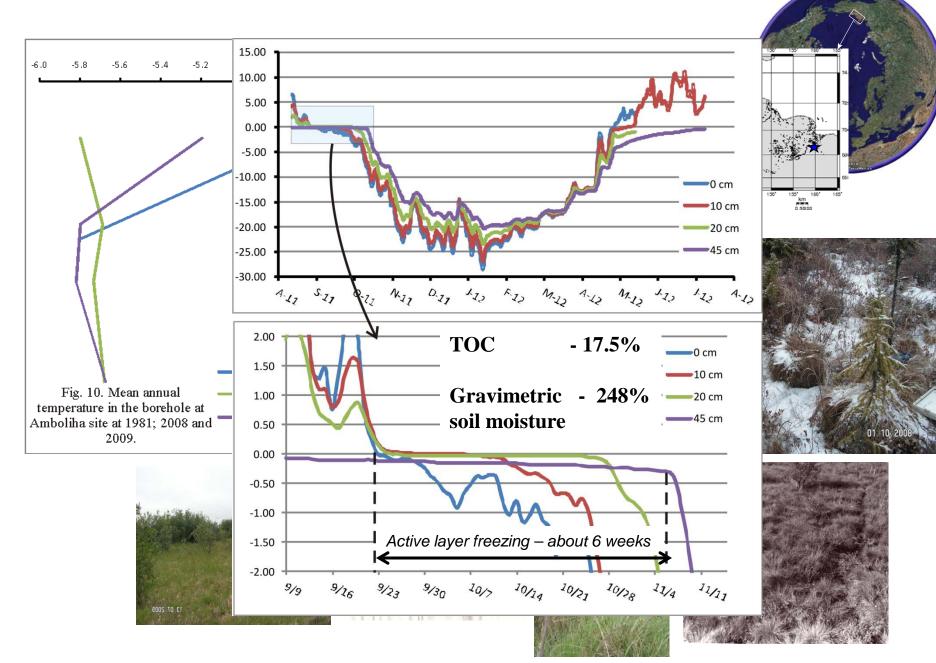


MAGT at the 25 m depth (2012) -6.1°C Positive trend, °C/year 0.035





#### FLOODPLAIN (AMBOLIHA)



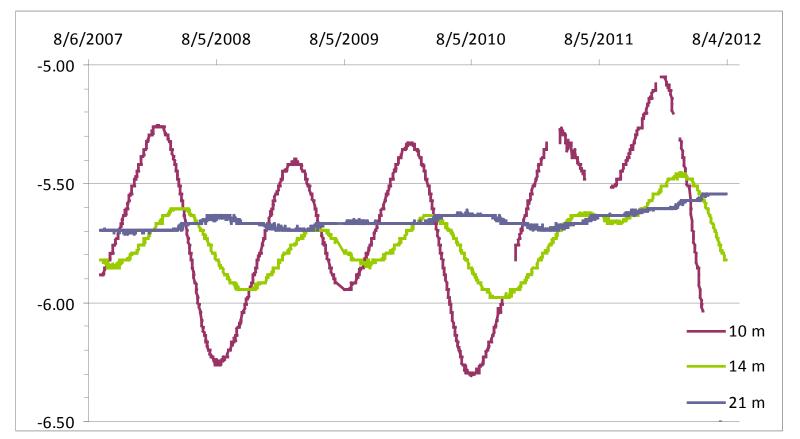


#### FLOODPLAIN (AMBOLIHA)



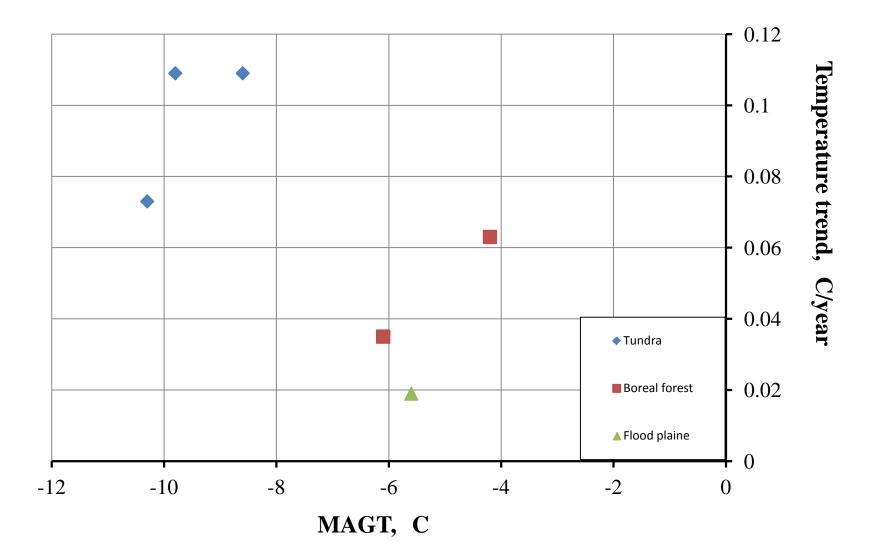


MAGT at the 21 m depth (2012) -5.6°C Positive trend, °C/year 0.019



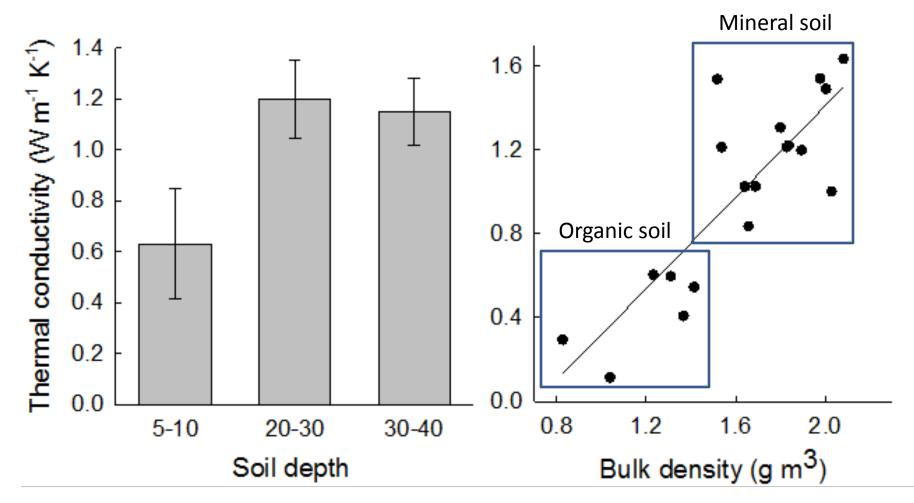
# **O** ESULTS: CORREALATION OF GROUND TEMPERATURE VALUES AND DYNAMICS WITHIN THE DIFFERENT LANDSCAPE TYPES

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RMAL CONDUCTIVITY OF ACTIVE LAYER SOIL IN THE INVESTIGATED AREA

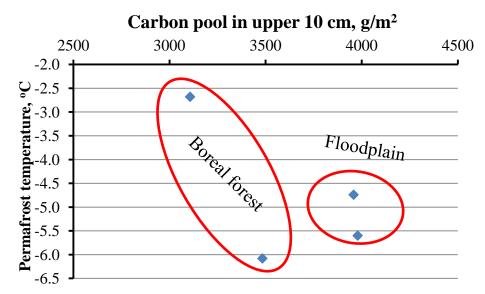
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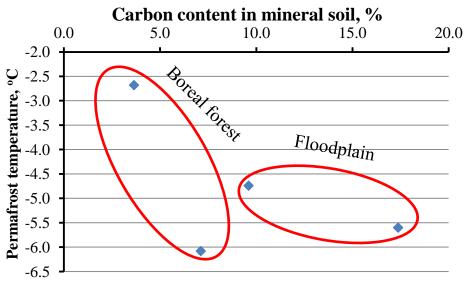


Left panel: Conductivity of organic (5-10 cm) soil was lower than mineral (20-40 cm). Right panel: The positive relationship between bulk density (low in organic soil) and thermal conductivity

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#### **CORRELATION OF PERMAFROST TEMPERATURE AND SOIL CARBON CONTENT**







### CONCLUSIONS

Mean annual permafrost temperature rising was recorded at the most of observation sites in the region.

Rate of rising changes from **0.03 C/year** within boreal forest natural zone to **0.1 C/year** in tundra. Within each of ecosystem types rate of permafrost warming strongly depends on local surface conditions.

Cooling natural factors such as higher *organic content in active layer* or *snow redistribution due to micro topography* reduce permafrost temperature and climate impact on its dynamics.

Ecosystems with *higher bioproductivity* are characterized by *lower rate of permafrost warming* 

Based on the current research we would **strongly recommend to take into consideration climate induced ecosystem changes** (i.e. vegetation structure, microtopography dynamics, increasing of bioproductivity and soil organic carbon accumulation) when doing long-term permafrost dynamics modeling and forecasts.



#### **DATA ACCESS**

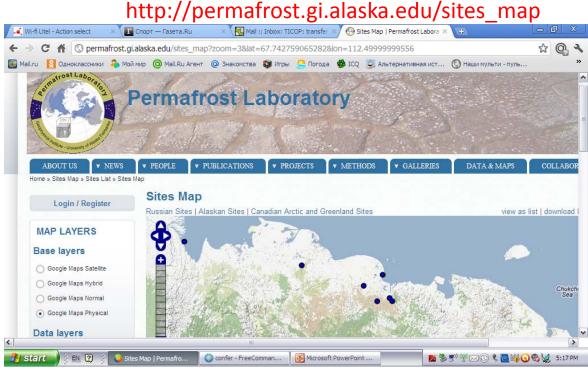
Results of measurements are available via Internet on the web site of the Cooperative Arctic Data and Information Service (CADIS)

WWW.AONCADIS.UCAR.EDU

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Geophysical Institute UAF, Permafrost laboratory web site

## WWW.PERMAFROSTWATCH.ORG





#### AKNOWLEDGEMENTS

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and

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