# Soil transplanting experiment: the initial results of coring the original permafrost peatland soils to the "warm" plots

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## Intro

### What & Why

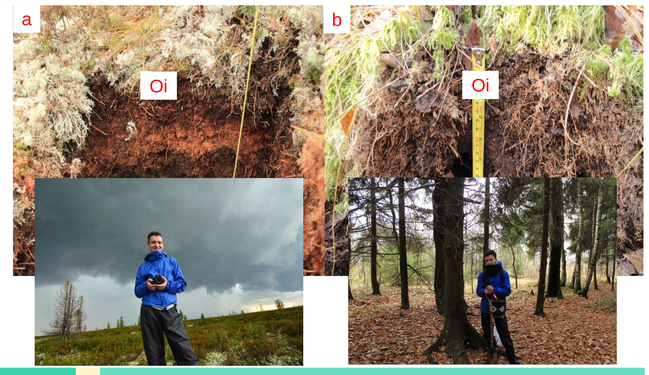
Several field methods are known to simulate warming effect on soils: passive nighttime warming, open-top field chambers, heat-resistence cables, overhead IR lamps. Most of them are of special technique needs (Aronson 2009). However the *soil transplanting method* is almost unused despite its cost-effectiveness and ability to warm soil under natural conditions (Tremblay 2018). So this study was performed to apply the soil transplanting method to simulate warming effect on permafrost peatland soils regarding the fact that peatlands in Russia contribute up to 35% of the global carbon stock in peatlands (Yu 2012) and it should be promptly focused on due to predictable climate changes.

### Where

We selected:

- permafrost-affected site in forest-tundra (a, "North site", Nadym, 65°18′55″N, 72°52′34″E), bog peatland ecosystem, typical soil – Cryic Histosol (WRB 2015);
- permafrost-unaffected site in southern taiga (b, "South site", Moscow (Chashnikovo), 56°1'36"N, 37°11'54"E), transit bog peatland ecosystem, typical soil – Gleyic Histosol (WRB 2015);






## Design

### Soil transplanting experiment

PVC pipe in soil

a) Transplanting within North site, 1-2

b) Transplanting from North to the South site, 1-3

### North site, Forest-tundra, soil coring

Aug 2016. Coring samples in PVC pipes from cold plot (1, t 5.5 °C, 0-10 cm layer) and transplanting them to the warm plot (2, t 11.8 °C, n=3). Control was included.

1

2

### South site, Southern Taiga, soil coring

Oct 2016. Coring samples in PVC tubes from Forest-tundra cold plot (1, t 5.5 °C, 0-10 cm layer) and transplanting them to the Southern Taiga warm plot (3, 12.9 °C, n=2). Control was included.

1

3

### North site, Field stage

$CO_2$ efflux measurements by surface chamber technique (Riveros-Iregui 2008) were taken during 10 days in aug. 2016 and repeated after 1 year in aug. 2017 (4).

4

### South site, Field stage

$CO_2$ efflux measurements by surface chamber technique (Riveros-Iregui 2008) were taken every month during may-october 2017 (5).

5

### North site, soil sampling

Soil cores for lab analysis were collected in aug. 2017 (6).

6

### South site, soil sampling

Soil cores for lab analysis were collected in oct. 2017 (7).

7

### Laboratory stage

In laboratory soil samples were analyzed on dissolved organic carbon content, DOC (0.5M $K_2SO_4$ extract, Kalbitz 2000,Makarov 2013, 8).

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### Laboratory stage

Microbial (basal) respiration of soil samples was also estimated under standard conditions (Ananyeva 2008, Creamer 2014).

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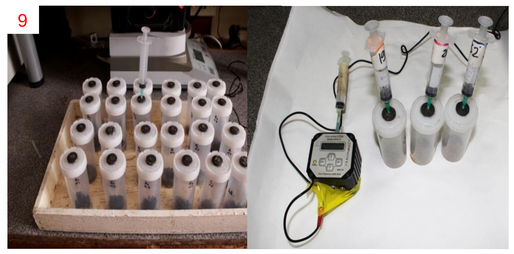
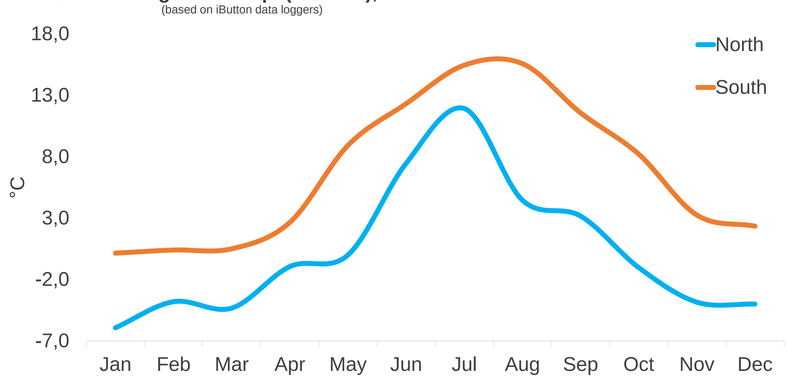


## Summary

### Support results

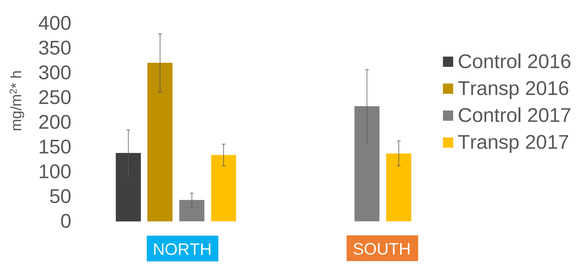
| | Layer | Permafrost | Soil moisture, % | Ash content, % | pH$_{H_2O}$ | Total organic C, % |
|---|---|---|---|---|---|---|
| North | Oi | From 50 cm | 747 | 9,9 | 3,9 | 40,7 |
| South | Oi | no | 1161 | 8,2 | 3,9 | 45,2 |

**Annual average soil temp. (0-10 cm), control**
(based on iButton data loggers)

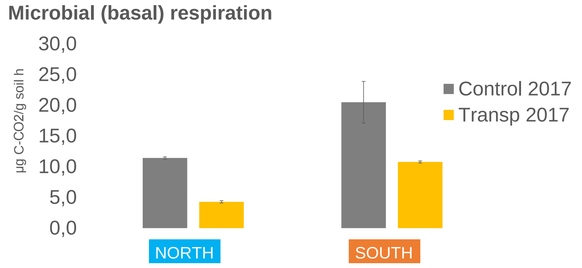



### Main results

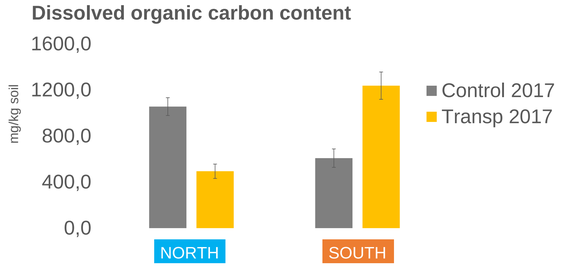
**$CO_2$ efflux**




**Microbial (basal) respiration**




**Dissolved organic carbon content**




### Conclusions

1. We found the intensive $CO_2$ efflux rate of north soils transplanted within the north site: both in short-term (10 days in 2016) and long-term (1 year, 2016-2017) cases the $CO_2$ efflux from "warm" plots was 3-4 times higher as compared to control. Otherwise the $CO_2$ efflux rate of north soils transplanted to the south site was 2 times lower than south control.
2. After 1 year of transplanting the microbial respiration of north site soils showed 2 times lower rate comparably to south site soils.
3. Instead of microbial respiration rate the DOC content of transplanted north site soils was 2.5 times lower in comparison with south site soils thus indicating the possible substrate depletion after 1 year of transplanting.
4. In summary we've found a different response of north site and south site soils to warming simulation. This fact should be considered when predicting the peatland soils respiration due to upcoming climate changes in permafrost areas.

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