Climate and Soil Temperature Variation in the Forest-Tundra Transition near Nadym, West Siberia, Russia

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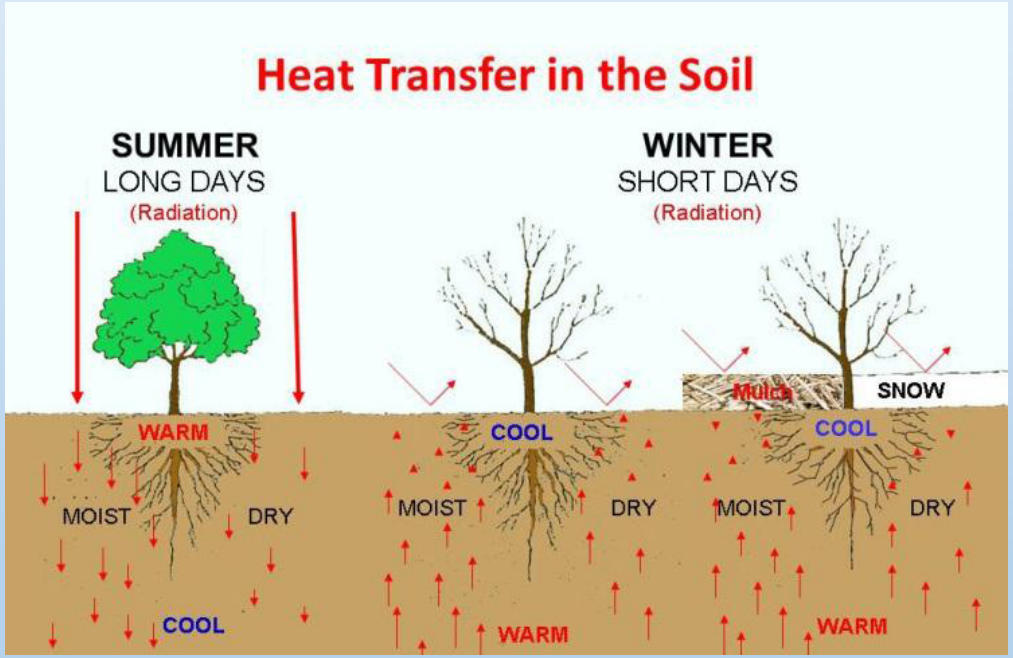
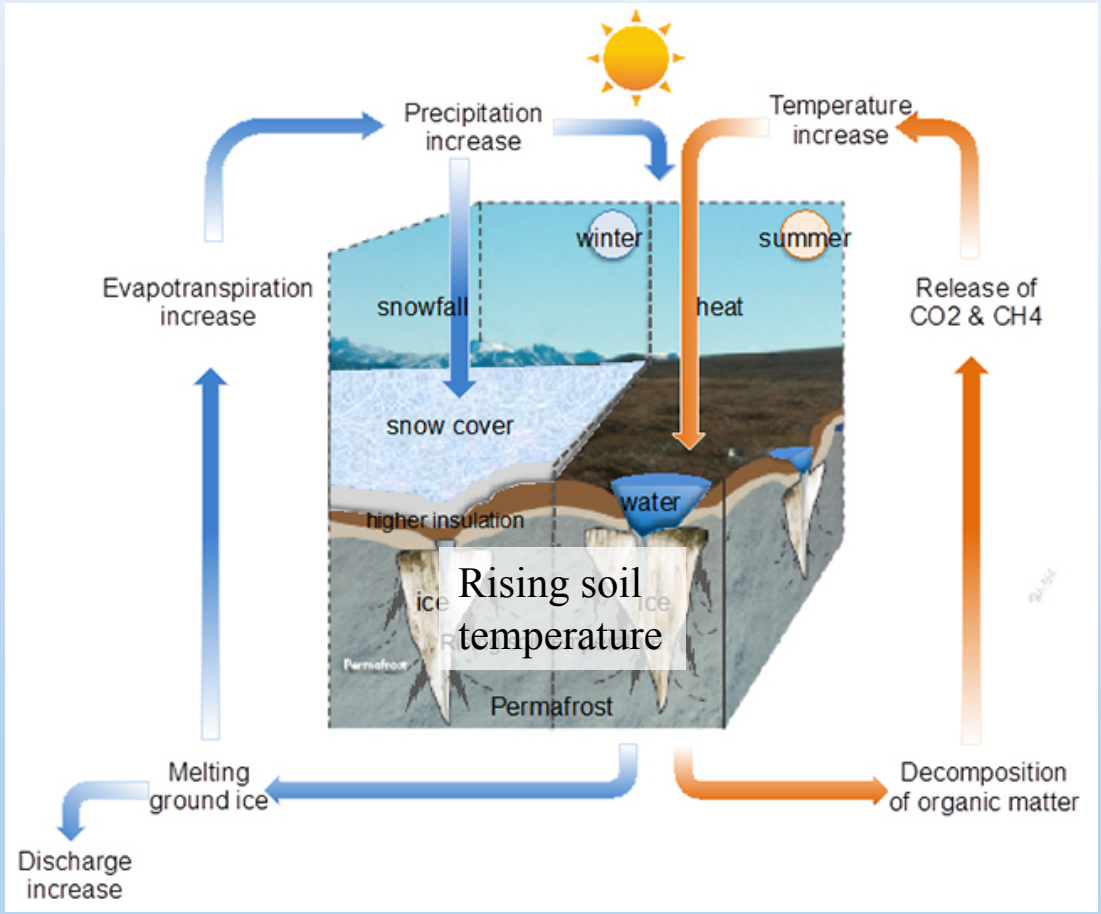
Soil temperature regime and climate change



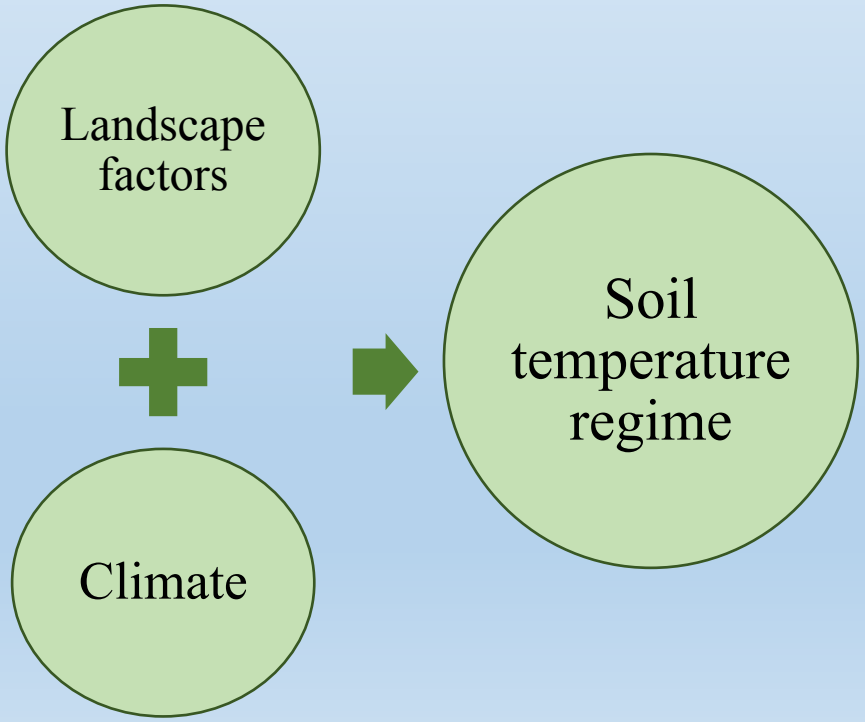
http://bongiornos.info



Effect of soil temperature change
(October 20, 2014 JAMSTEC)

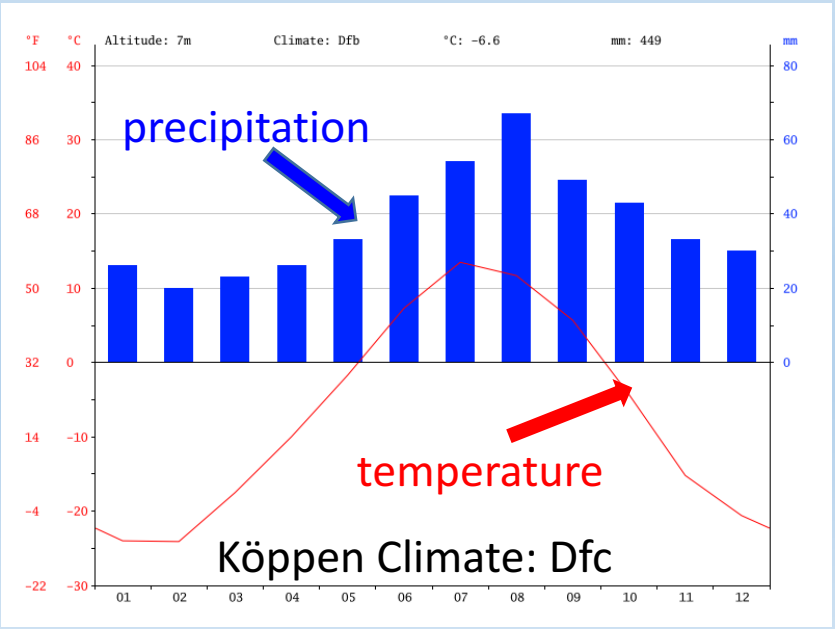
Main objectives

- Characteristics of soils temperature regimes
- Relationship of the soil temperature regime with the climatic characteristics



Study site

The mean annual air temperature -5.0°C. Annual precipitation ranging from 450 to 650 mm.

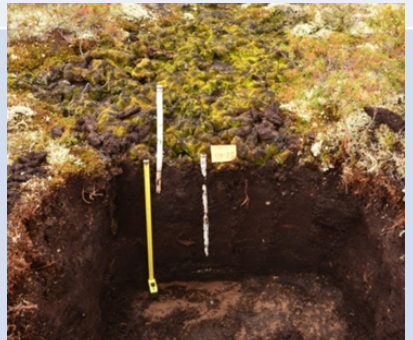


Permafrost distribution map and location of the study area in the west Siberia region, Yamal, Russia.

Credit: Map by Philippe Rekacewicz

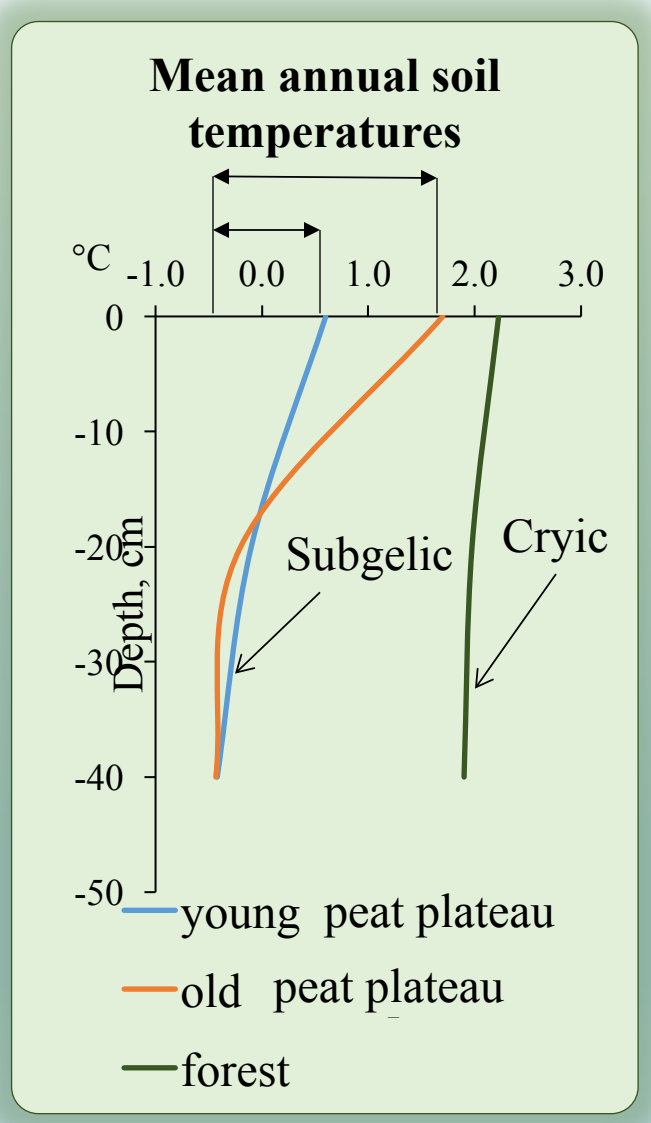

Forest ecosystems
Young peat plateau (palsa)
Old peat plateau (palsa)
By Matyshak G., 2013

Sites' general description

Coordinates	Site name	Level over the bog, м*	Vegetation	Soil (Soil Taxonomy/ WRB)		Active-layer, м
N65°18'52.8" E72°52'54.2"	Forest	0,45-0,55	Pinus sibirica, Larix sibirica, Betula sp. Ericaceae Polytrichum strictum, Cladonia rangiferina, Sphagnum sp.	**Typic Haplocryods** / Stagnic Albic Podzol		-
N65°18'54.4" E72°52'10.0"	Young peat plateau, CALM R1	0,30-1,20	Cladonia rangiferina, stellaris, sylvatica, Sphagnum sp, Betula nana, Rubus chamaemorus, Ledum sp., Vaccinium uliginosum, Vaccinium myrtillus	**Typic Histoturbels** /Histic Oxyaquic Turbic Cryosol		0,7-2,0
N65°18'55.1" E72°52'33.9"	Old peat plateau	1,90-3,00	Ledum sp., Betula nana, Cladonia sp.	**Typic Historthels** / Murshic Hemic Cryic Histosol		~0,5

* relatively minimal point of the bog, taken as 0 meters

Annual temperature regime (average data for 5 years)

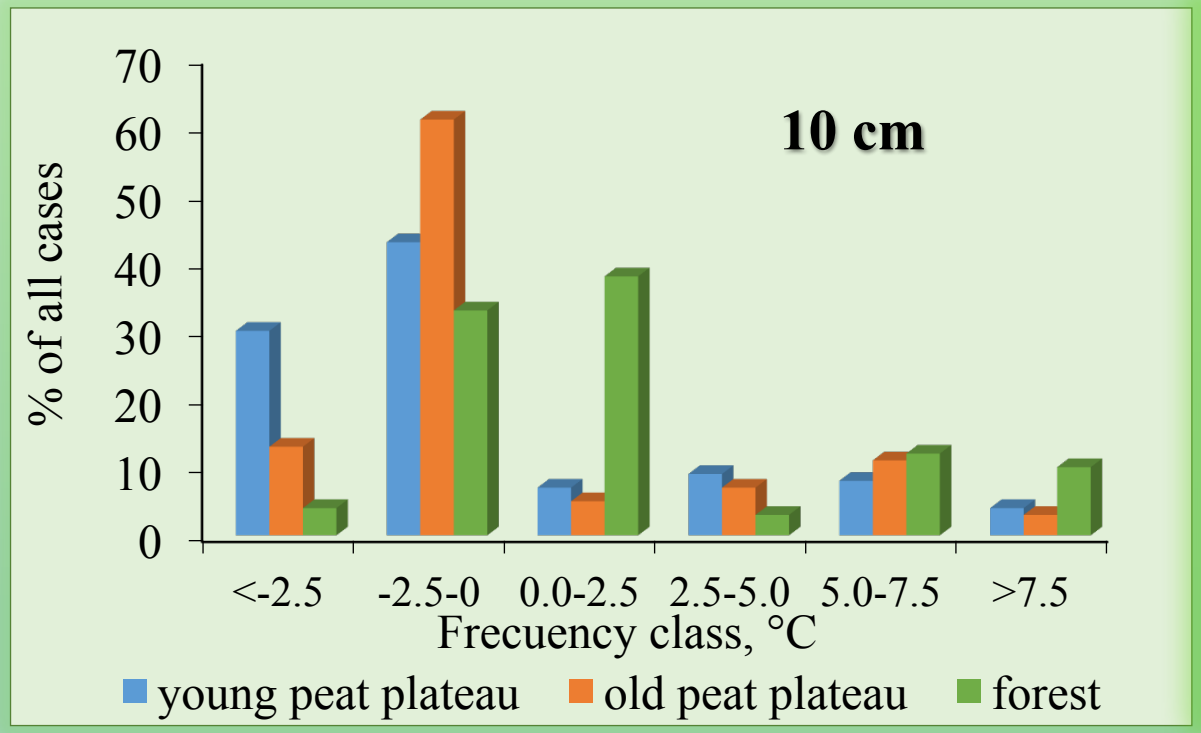


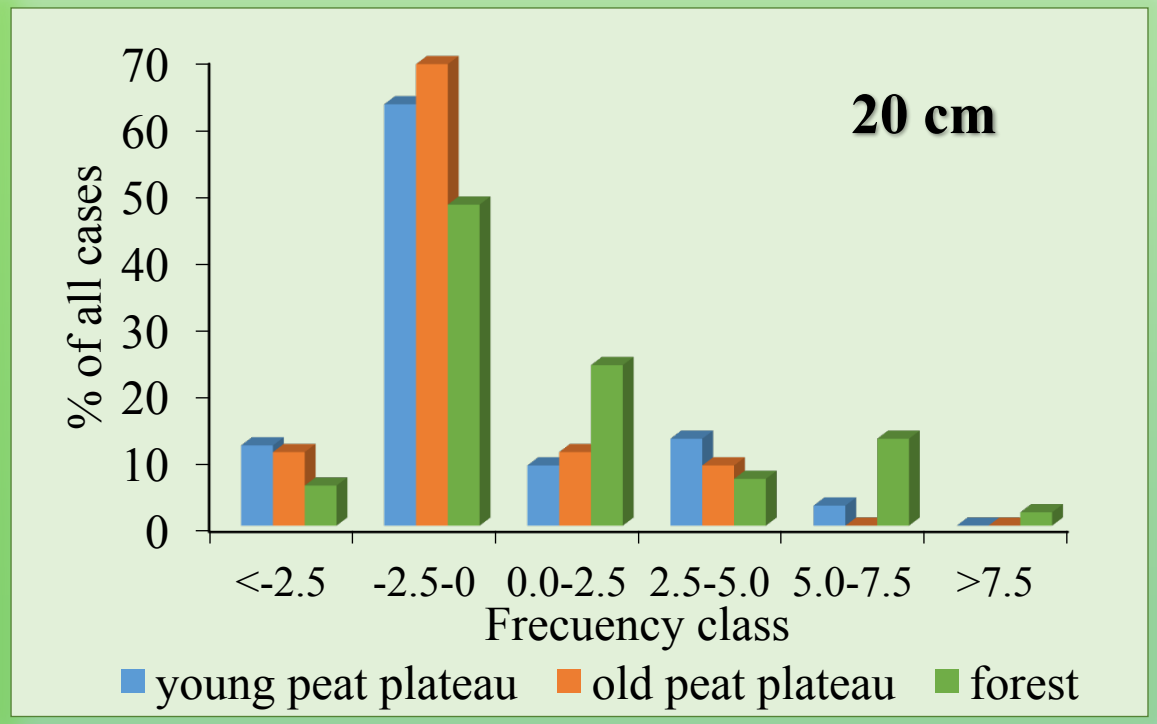
Annual temperature indexes

Average temperature of the coldest month	Freezing degree-day sums	Average temperature of the wamest month	Thawing degree-day sums	Annual amplitude of temperature (warmest - coldest)	Period with temperature <0 °C
at 20 cm depth, °C					at 20 cm depth, days
young peat plateau					
-4,8	-517	6,4	391	11,8	206
old peat plateau					
-4,6	-504	6,9	288	11,6	242
forest					
-1,1	-96	9,1	664	10,2	63

Annual temperature regime

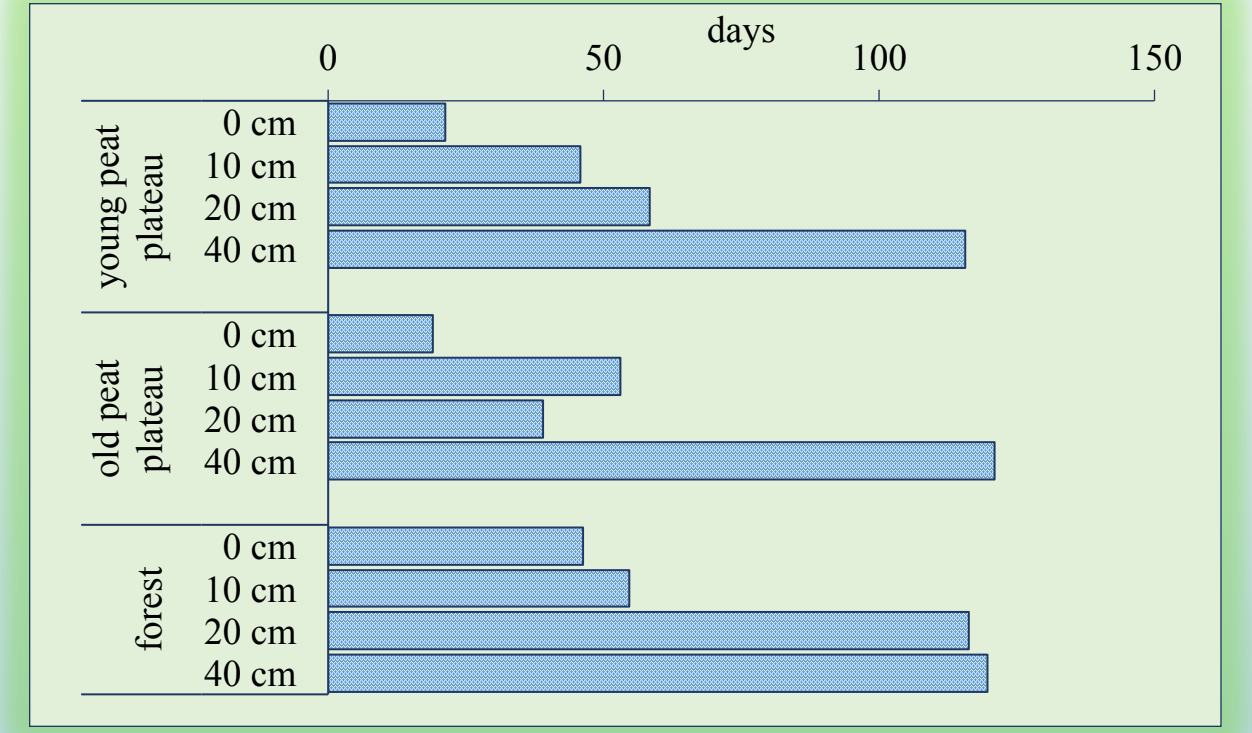
Relative frequency distribution of average daily soil temperatures





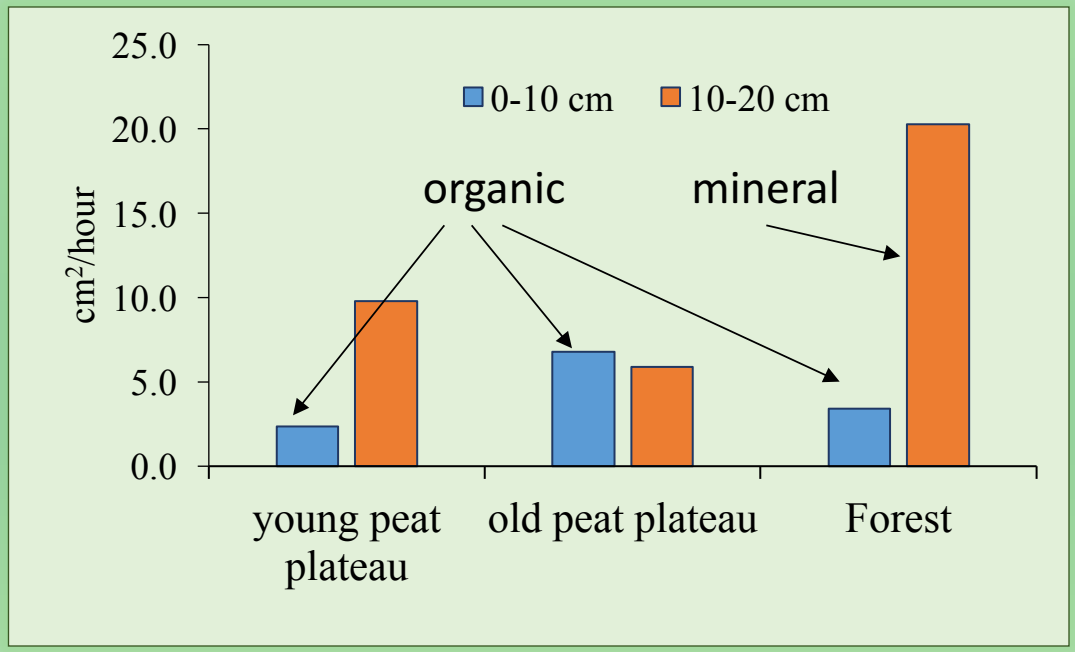
Soils of the study area are functioning all-year in a narrow range of temperatures. More than half of the daily soil temperatures are ranged from **-2,5°C to 0°C**.

Effect of soil properties on soil temperatures

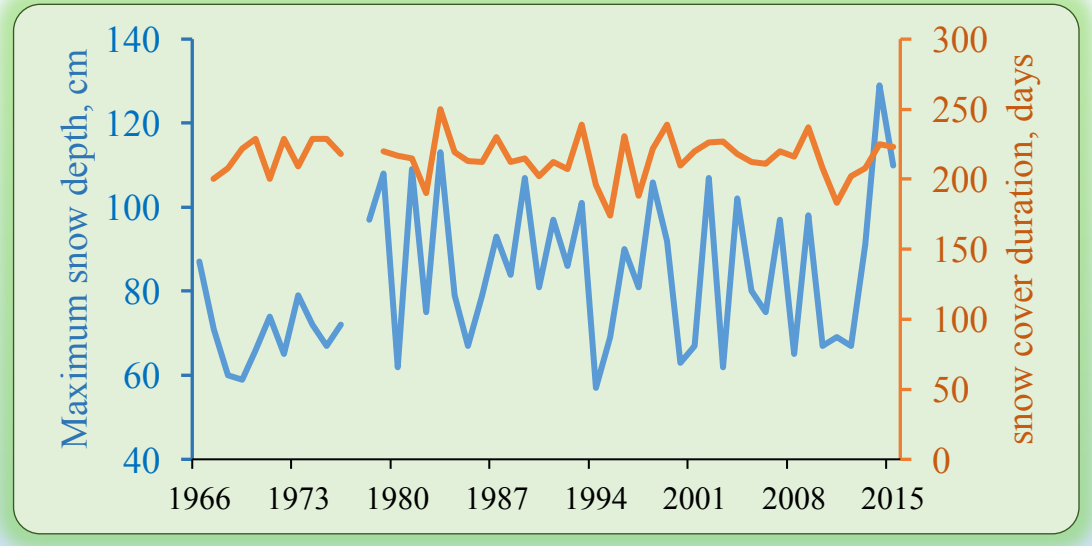


The duration of the zero curtain (days with a temperature of 0°C in spring and autumn) for key landscape soil profiles (average data for 5 years)

Thermal diffusivity of the upper soil horizons (average values were calculated for five randomly selected days during the period from June to September 2015)

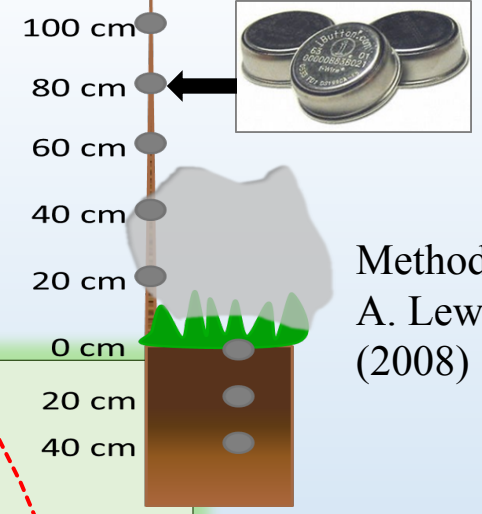


Snow cover regime



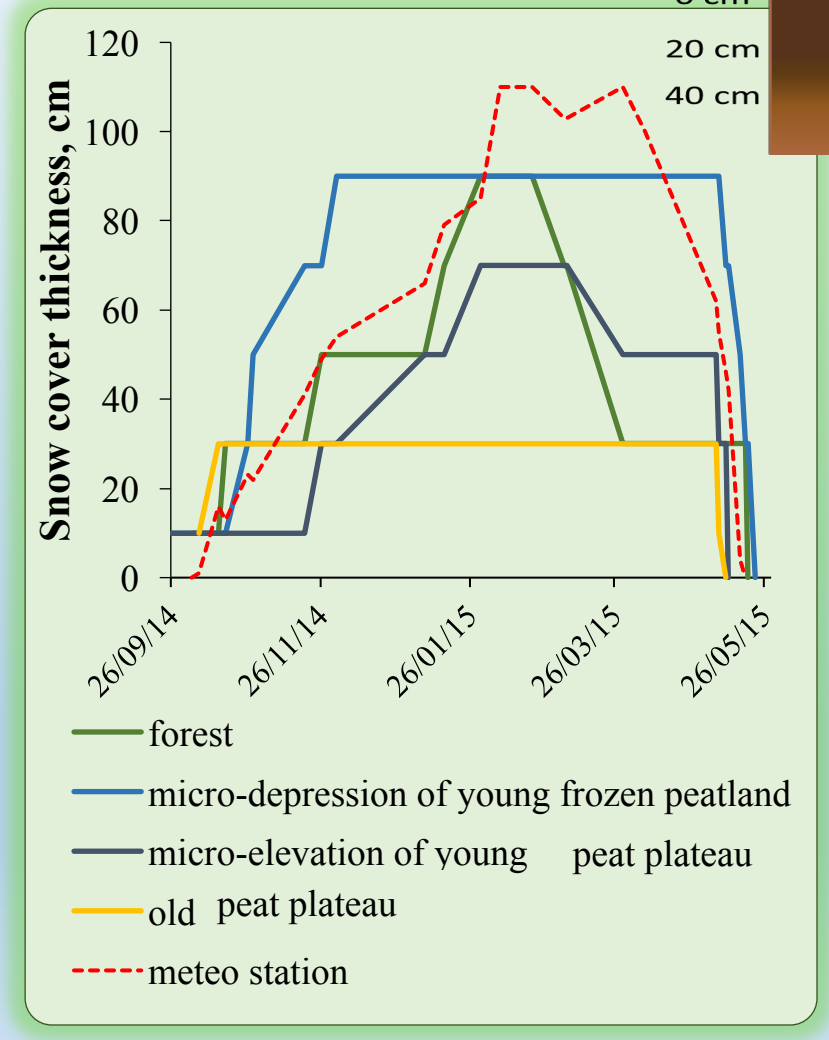
Climatic data from the meteorological stations near Nadym town for the period from 1966 to 2015 (http://aisori.meteo.ru/ClimateR).

site	n_f
young peat plateau	0,35±0,11
old peat plateau	0,28±0,10
forest	0,12±0,08

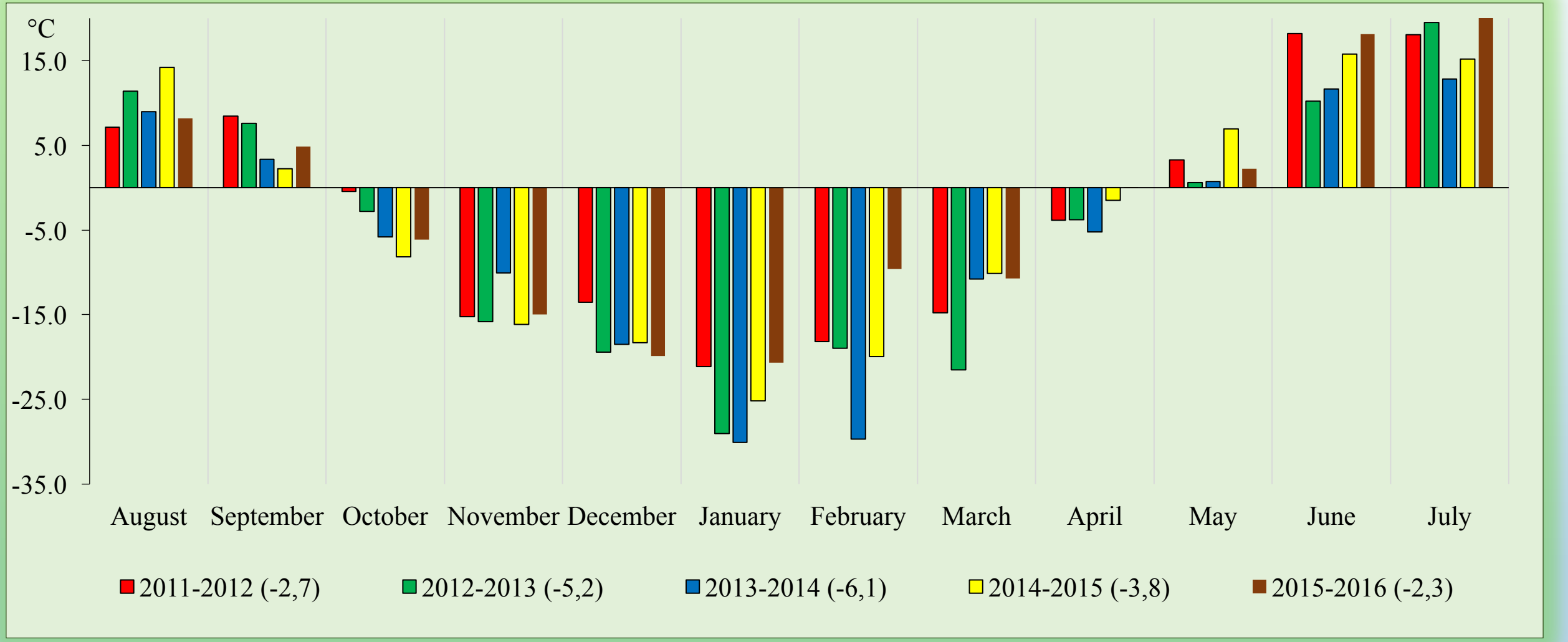


Method by A. Lewkowicz (2008)

Interpreted snowpack development at key landscapes. Snow levels are shown halfway between covered and exposed temperature-logger levels



The interannual variability of temperature conditions



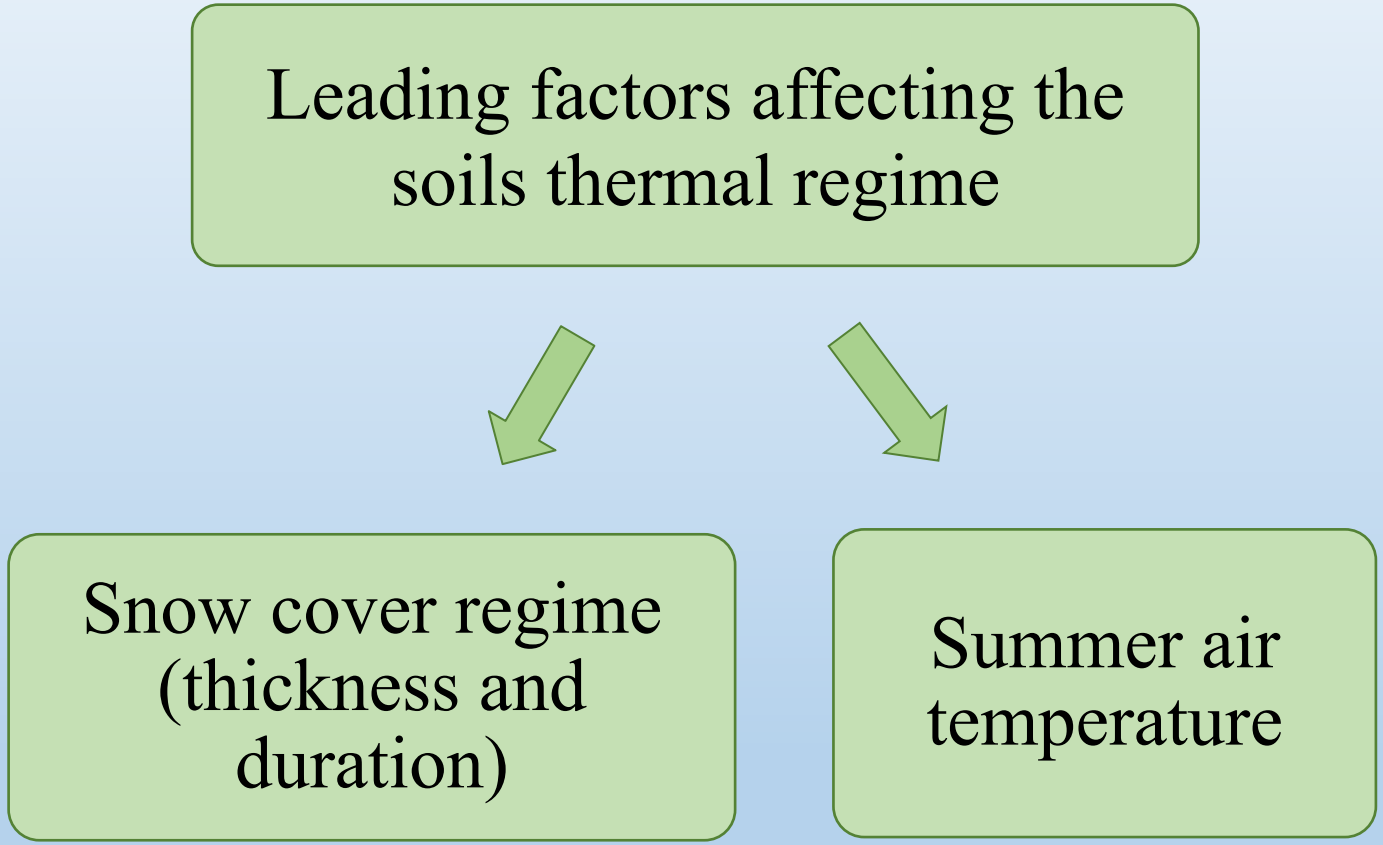
Average monthly air temperatures according to microclimatic measurements (in the brackets of the legend - the average annual air temperature, °C).

The interannual variability of temperature conditions

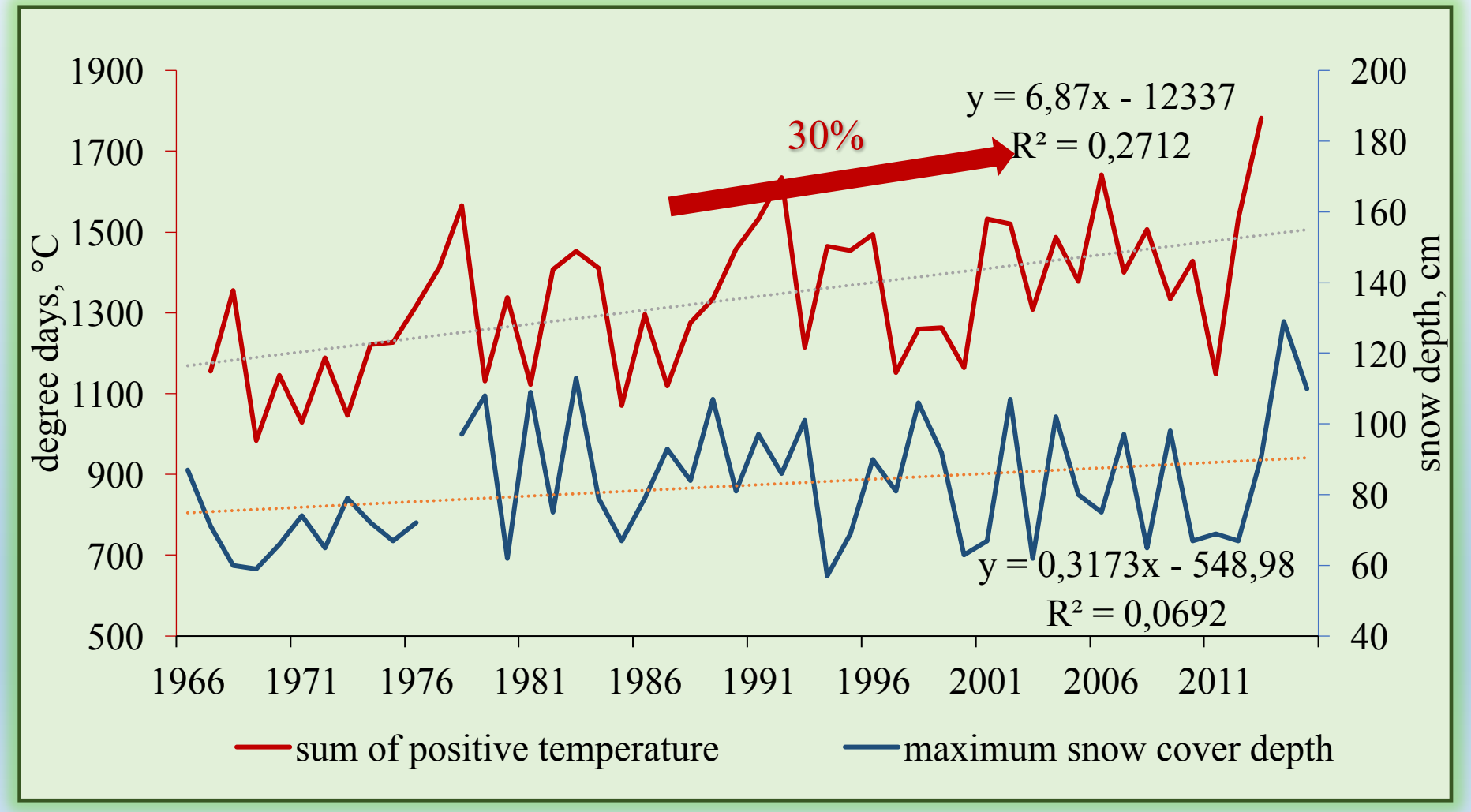
Annual air and soil temperature indicators for young peat plateau

Years	Mean air temperature, °C	Sums of air degree-days above 0°C	Maximum snow depth, cm	Mean snow depth, cm	Mean soil temperature, °C	Mean temperature of the warmest month, °C	Sums of degree-days above 0°C	Mean temperature of the coldest month, °C	Sums of degree-days below 0°C	Nf	Nt
		meteo station			at depth of 20 cm						
2011/12	-2,7	1559	73	43	-0,1	6,2	369	-4,8	-502	0,37	0,88
2012/13	-5,2	1221	89	47	-1,0	4,6	205	-7,4	-703	0,31	0,71
2013/14	-6,1	978	129	67	0,1	4,5	264	-2,9	-297	0,17	0,82
2014/15	-3,8	1447	111	68	0,6	9,3	699	-5,1	-639	0,43	0,79
2015/16	-2,3	1577	129	50	-0,1	7,6	419	-3,9	-444	0,45	0,74

Implications of climate change to soil temperature



Meteorological data from the weather station ‘Nadym’ for the period from 1966 to 2015



Conclusions

1. Subgelic and Cryic temperature regime with different heat supply.
2. Functioning in a narrow temperature range (slightly below zero).
3. Geocryological conditions in the study area will change as **gradually** with the continued increase in summer temperatures, and, perhaps, **sharply** with a certain combination of climatic factors due to their high variability.

Thanks for attention