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WETLANDS AND LAKES IN SOUTHERN TUNDRA OF WESTERN SIBERIA: LANDSCAPE STRUCTURE AND METHANE EMISSIONS

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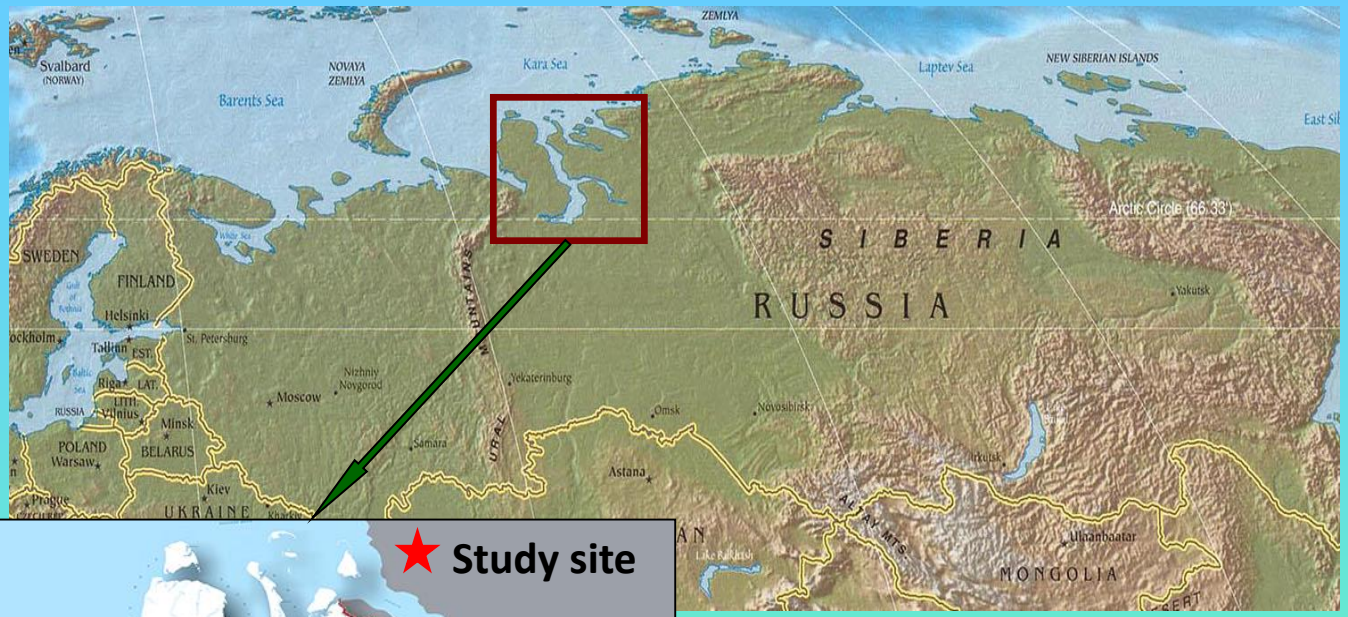
STUDY REGION IN WESTERN SIBERIA



Yasavey（67°35’ N, 78°91’ E）

Yarneto （67°22’ N, 78°37’ E）

Gaz-Sale（67°21’ N, 78°42’ E）

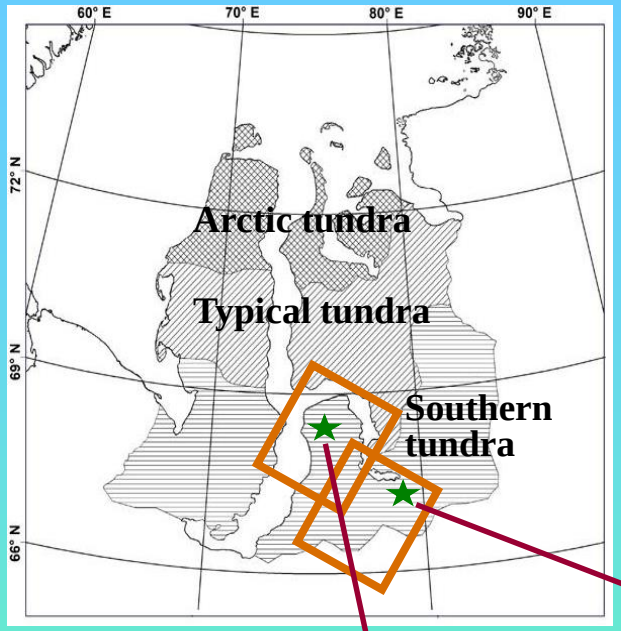
Aims of our research:

- analysis of the landscape/microlandscape structure of ecosystems based on satellite data and field surveys,

- to evaluate methane exchange between the atmosphere and wetland/lake ecosystems

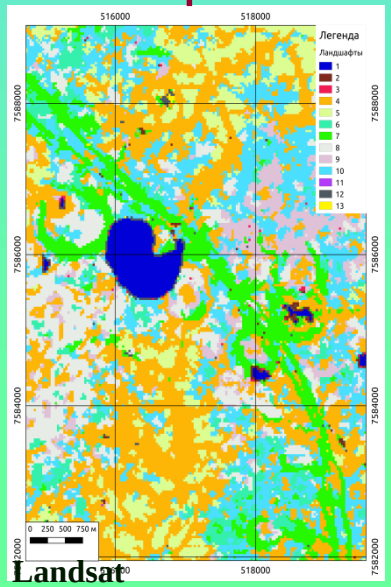
in southern tundra of Western Siberia.

ANALYSIS OF THE LANDSCAPE STRUCTURE BASED ON SATELLITE DATA

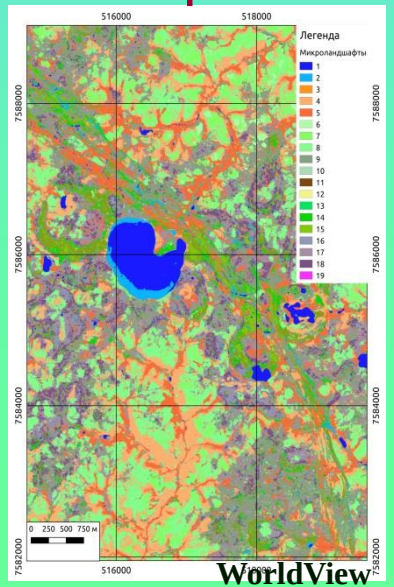


Landsat-8: **medium-resolution satellite images**
spatial resolution: 30 m per pixel; image area: 36 200 km^2

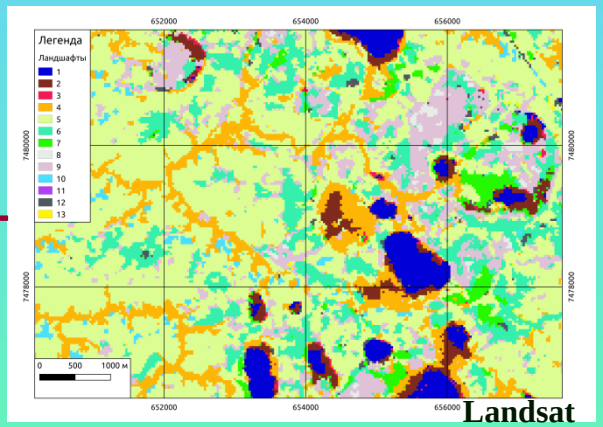
WorldView-2: **high-resolution satellite images**
spatial resolution: 2 m per pixel; image area: 40 km^2



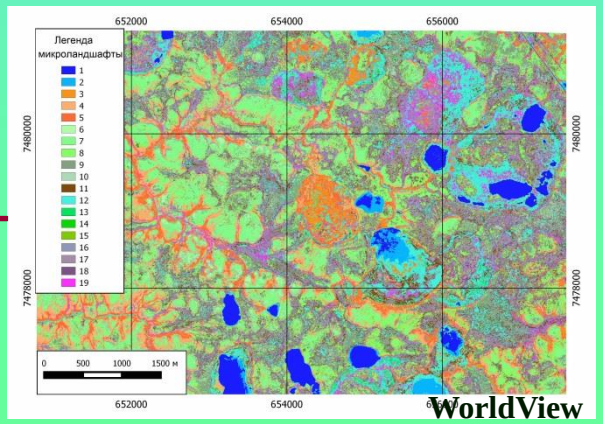
Landsat



WorldView



Landsat



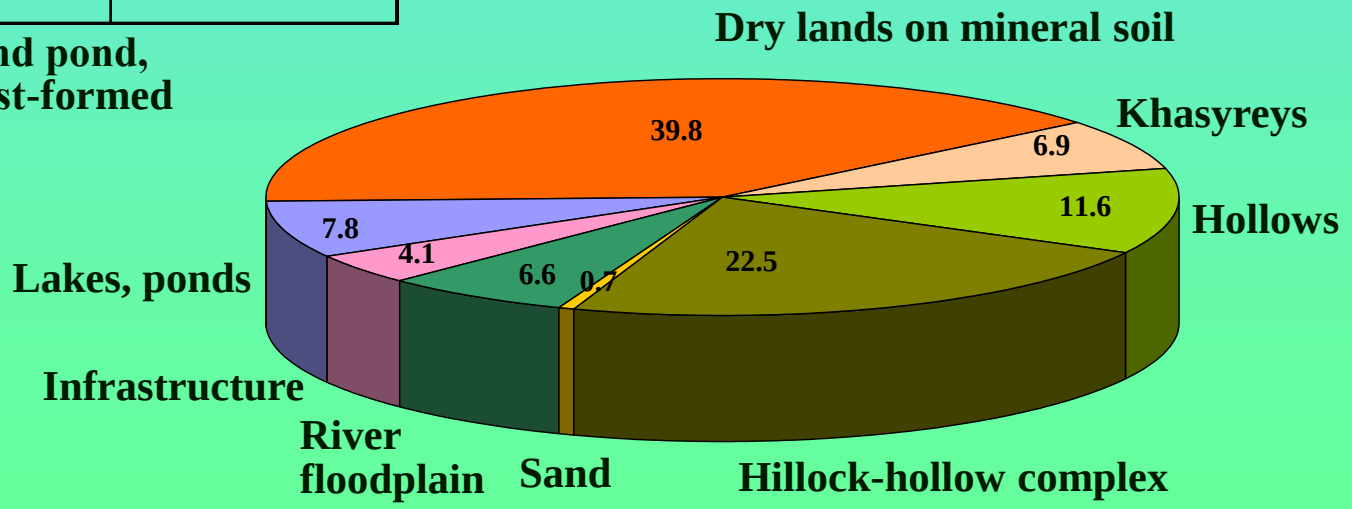
WorldView

Landscapes	Number of type
Water	1
Dry land on mineral soil	2
Khasyrey	2
Hollow	3
Hillock-hollow complex	2
River floodplain	1
Sand formation	1
Territory under infrastructure	1

Here “Water” is lakes and pond, “Khasyrey” is permafrost-formed dry lake basin.

An analysis of the Landsat-8 images made it possible to differentiate 13 classes of tundra landscapes.

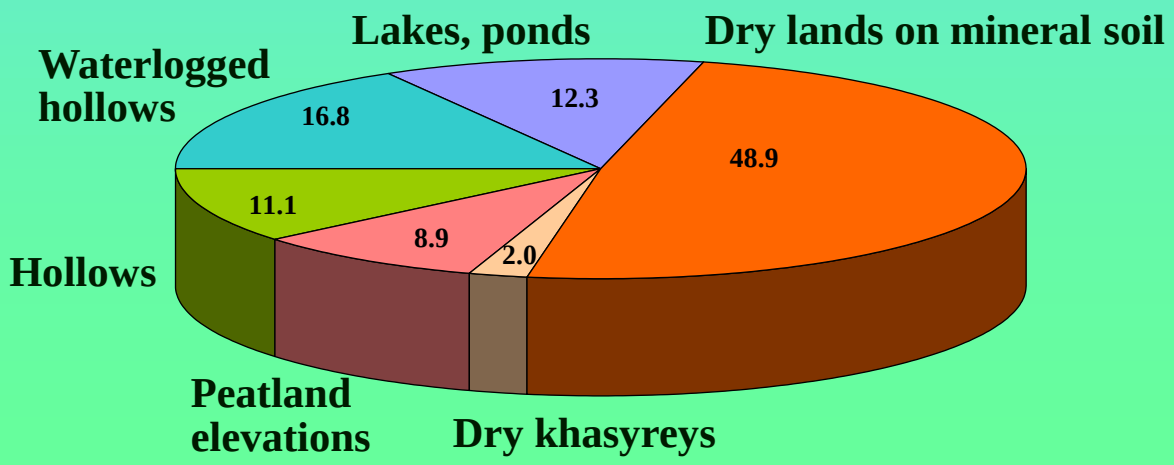
Structure of the landscape areas (%) in the Landsat images



Microlandscapes	Number of type
Water	3
Dry lands on mineral soil and dry khasyreys	6
Peatland elevations (hillocks, rollers, etc.)	2
Hollows	3
Waterlogged hollows	5

An analysis of the WorldView-2 images made it possible to differentiate 19 classes of the land surface (microlandscapes).

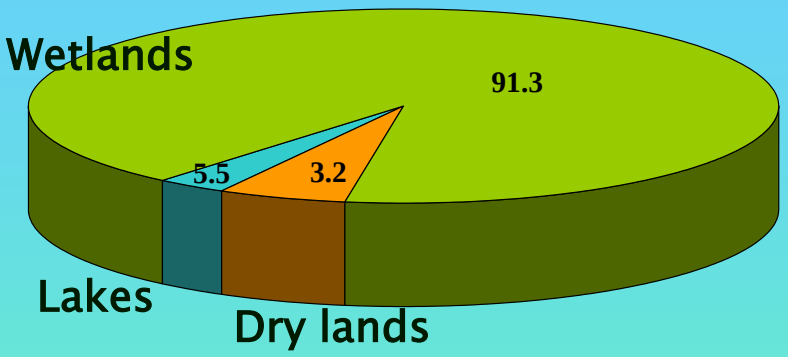
Structure of the microlandscape areas (%) in WorldView images



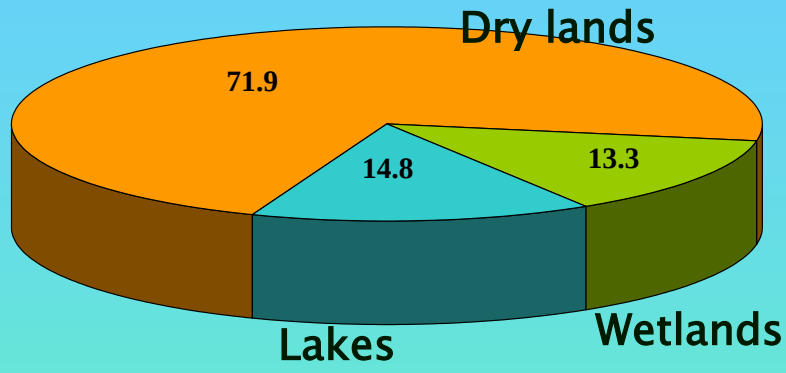
COMPARISON LANDSCAPES AND MICROLANDSCAPES

Landscape *"Wetland khasyrey"*

Microlandscape:

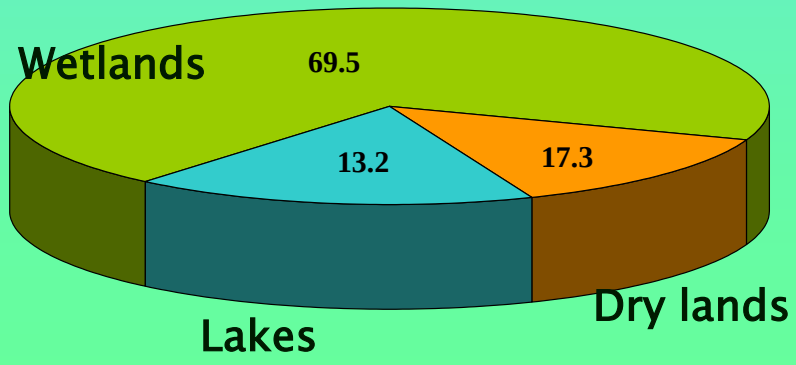


Landscape *"Dry land with shrubs on mineral soil"*

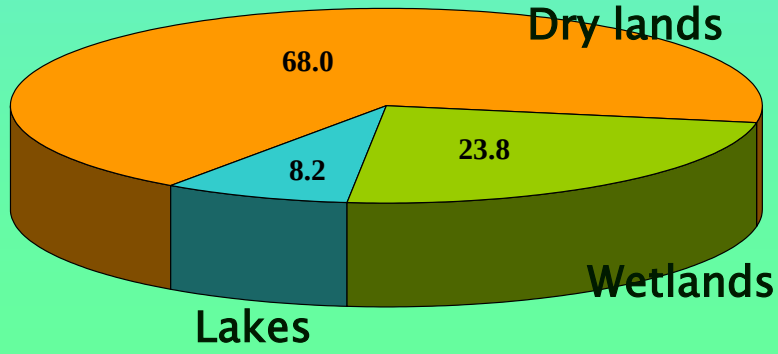


Landscape *"Hollow"*

Microlandscape:



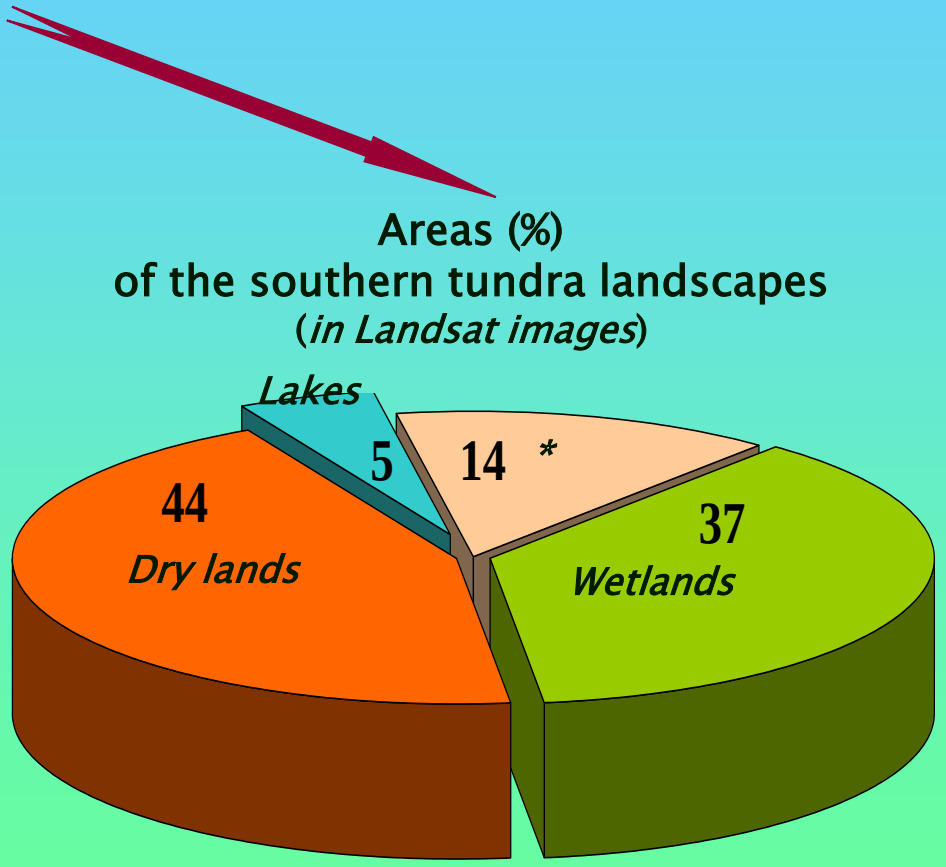
Landscape *"Dry shrub-grass-lichen land on mineral soil"*



% of the landscape area

MICROLANDSCAPE AREAS
IN THE SOUTHERN TUNDRA OF WESTERN SIBERIA

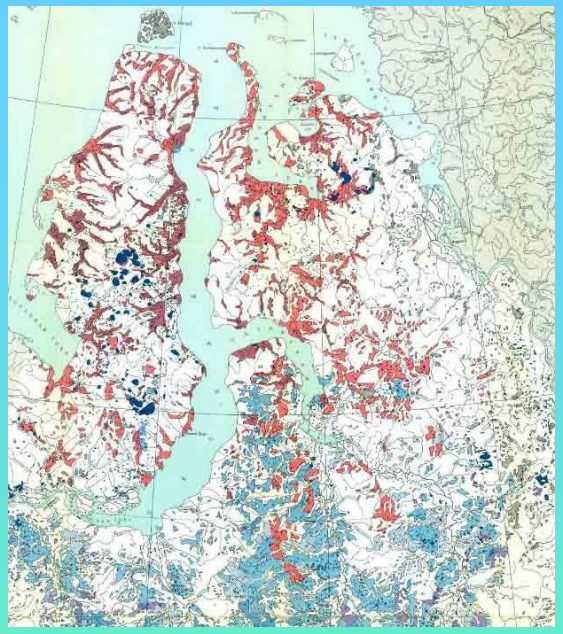
Using the GIS GRASS the classes singled out in the WorldView-2 images were compared with those in the corresponding Landsat-8 images.

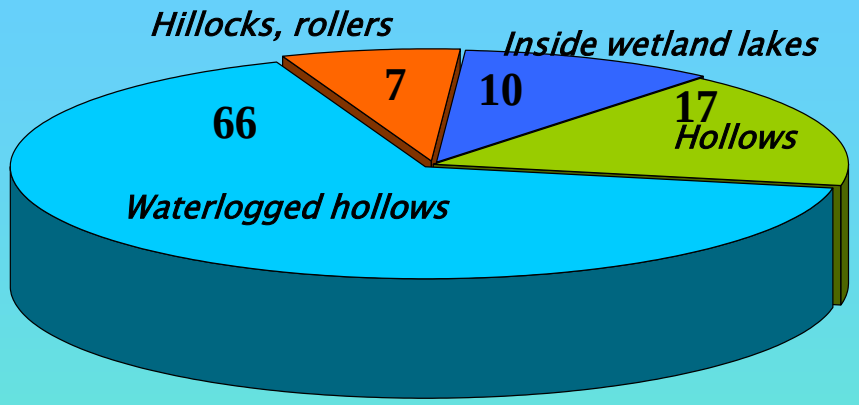


** – River floodplains, Sand formations, Territory under infrastructure*

WETLAND MICROLANDSCAPE AREAS IN THE SOUTHERN TUNDRA OF WESTERN SIBERIA

The Wetlands Typological Map





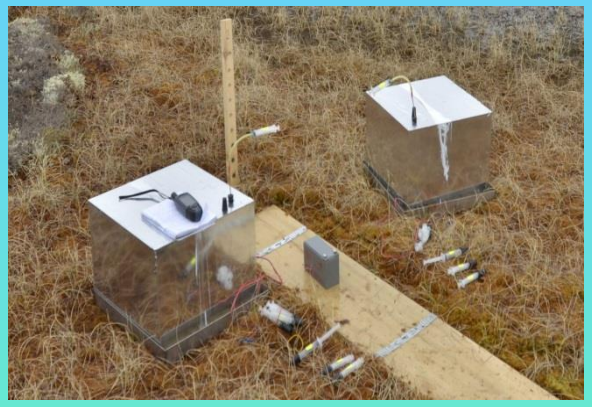
(% of the southern tundra area)

Wetlands	
	Polygonalroller and polygonalfissure bogs *Полигонально-валиковые и полигонально-трещиноватые*
	Polygonal bogs combined with grass and mossdominated bogs *Полигональные в сочетании с травяными и травяномоховыми*
	Patterned (hollow and hollowpool) flatpalsa bogs *Плоскобугристо-мочажинные и плоскобугристо-мочажинноозерковые*
	Flatpalsa bogs combined with highpalsa bogs *Плоскобугристые в сочетании с крупнобугристыми*
	Shrub dominated tussock bog. *Кустарничковые мелкокочковатые*

MEASUREMENT AND ANALYSIS OF METHANE FLUXES

We used dark static chambers with manual sampling.

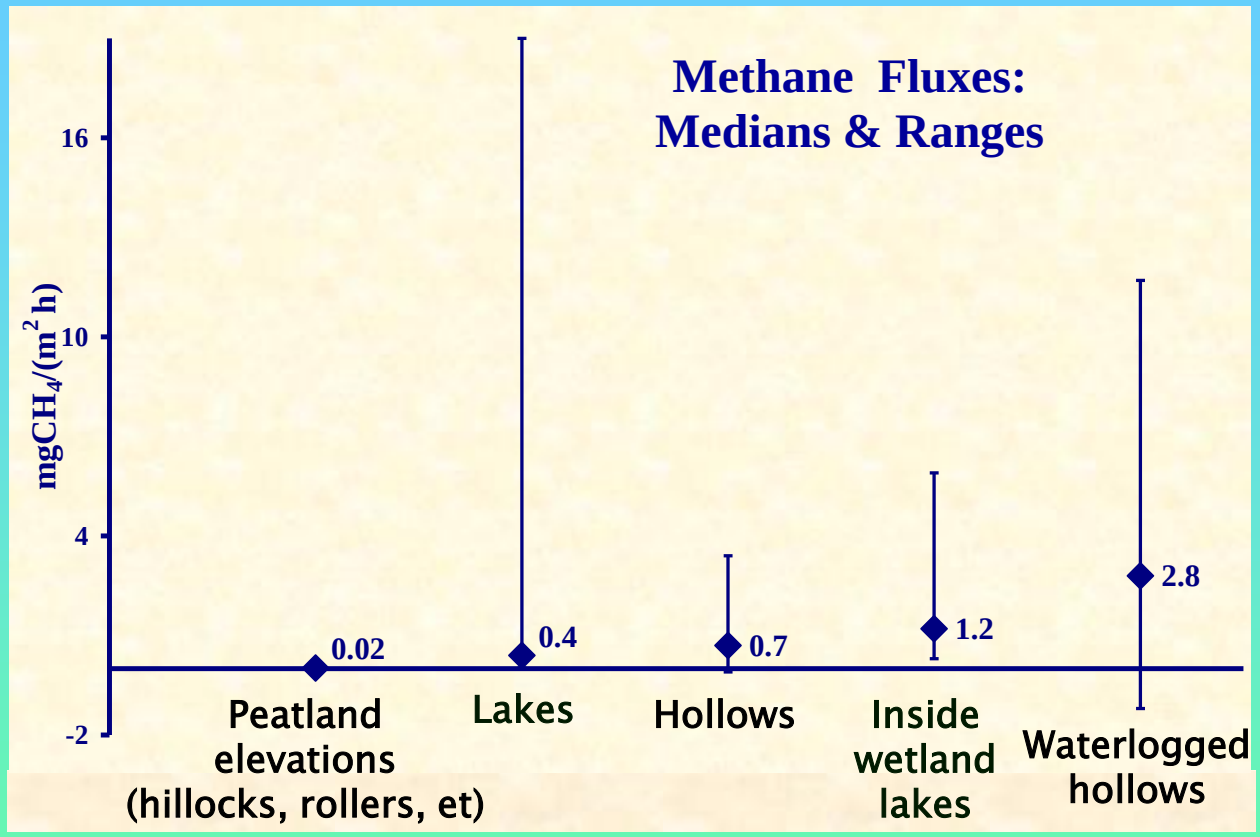
The total time exposition was 30-60 minutes. During this period, four samples were taken with an interval of 10-15 minutes including initial moment.



The gas samples were taken for each microlandscape.

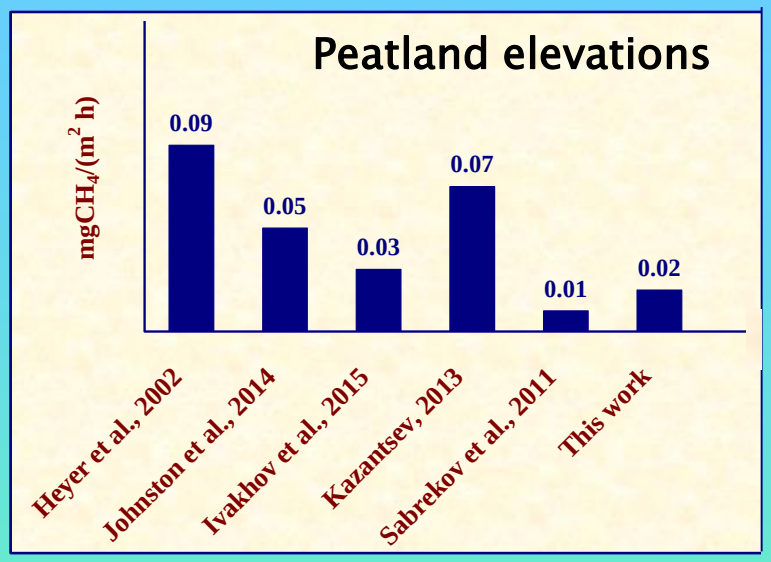
Methane concentration in samples was analyzed using a gas chromatograph (Crystal-5000.2) with a flame ionization detector.

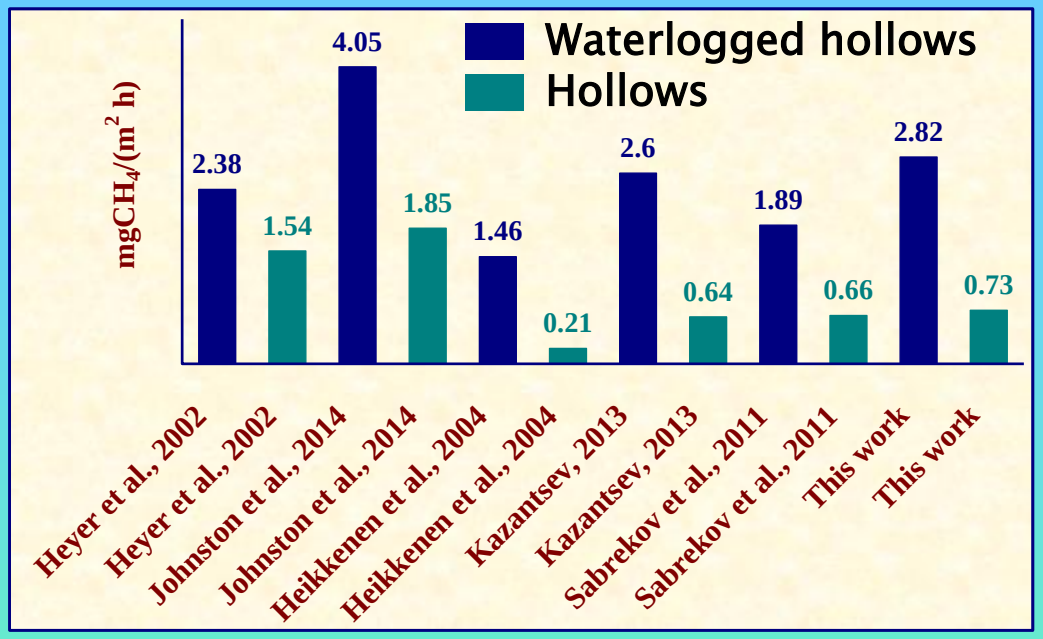
RESULTS OF MEASUREMENTS

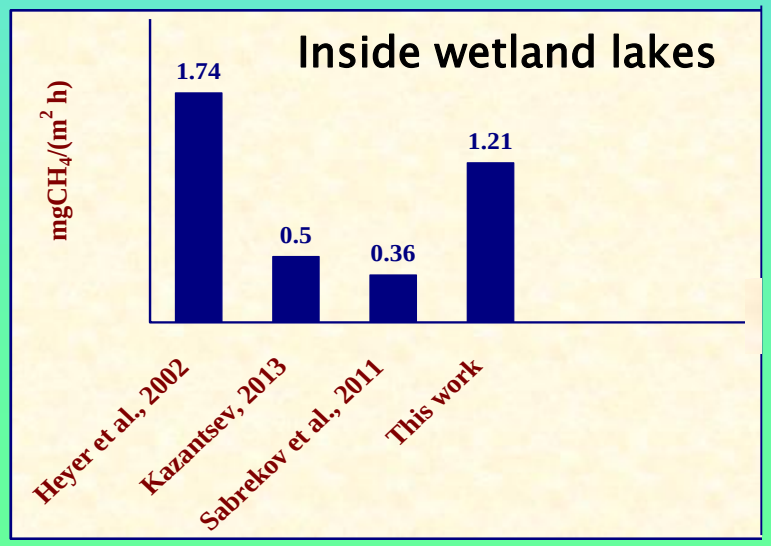


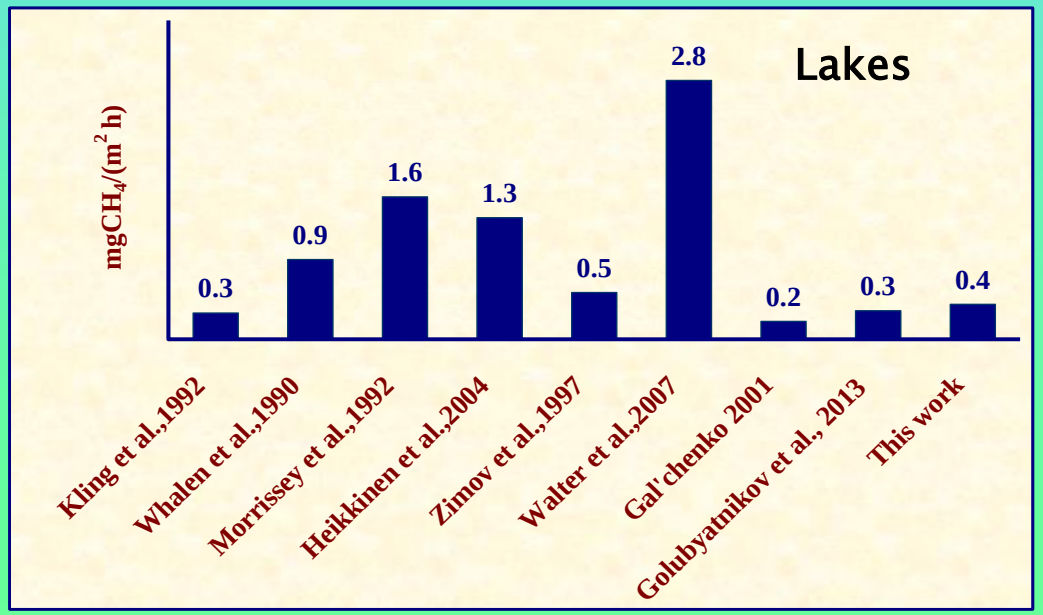
Negative numbers mean atmospheric uptake by the ecosystems, positive – loss to the atmosphere.

METHANE FLUXES FROM WETLAND MICROLANDSCAPES IN TUNDRA









LOCATION OF FIELD RESEARCH AREAS

Ice cover season:
September–June

Time period
of expeditions: June & July 2015, 2016

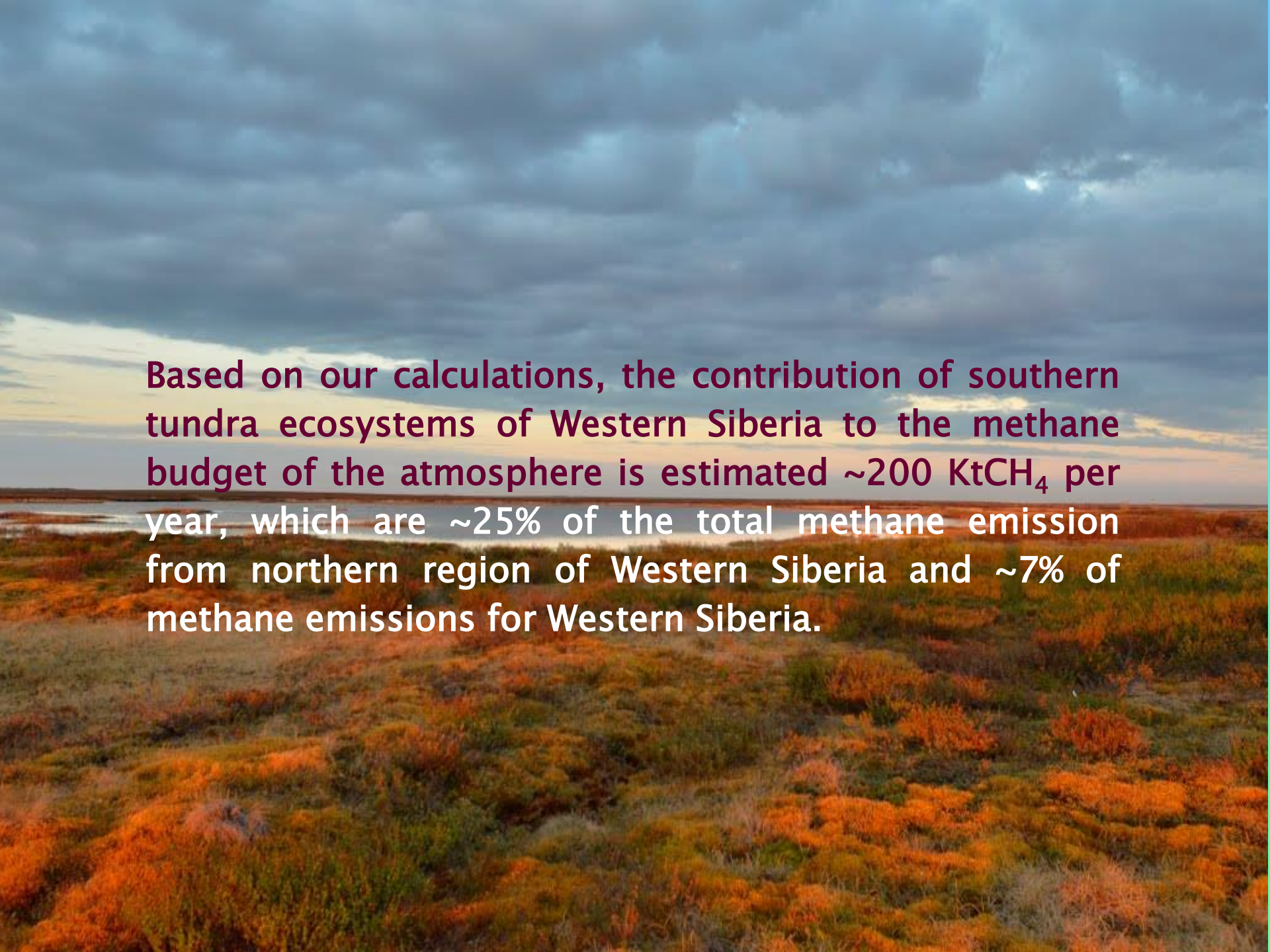
Lake №1:
area: 5×10^3 m^2,
depth: up to 2.0 m,
sediments: sapropel,
C content in sediments: 10.2–37.6%

Lake №1
(67.38N, 78.61E)

Lake №2
(67.36N, 78.61E)

Lake №2:
area: 91×10^3 m^2,
depth: up to 1.8 m,
sediments: silty and clay,
C content in sediments: 3.6–4.9%


Calculated spring methane emissions for southern tundra lakes in Western Siberia are ranged from 10% to 40% of the total methane emission from the lakes during the warm period.



Based on our calculations, the contribution of southern tundra ecosystems of Western Siberia to the methane budget of the atmosphere is estimated ~200 $KtCH_4$ per year, which are ~25% of the total methane emission from northern region of Western Siberia and ~7% of methane emissions for Western Siberia.

CONCLUSIONS

- A significant part (~83%) of the wetlands in the southern tundra of Western Siberia is occupied by hollow microlandscapes. Peatland elevations and lakes in the wetlands under consideration occupy ~7% and ~10% of the area respectively.

- The annual methane emissions for southern tundra of Western Siberia is evaluated as 200 Kt CH_4, which is about 7% of methane emissions for Western Siberia.

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