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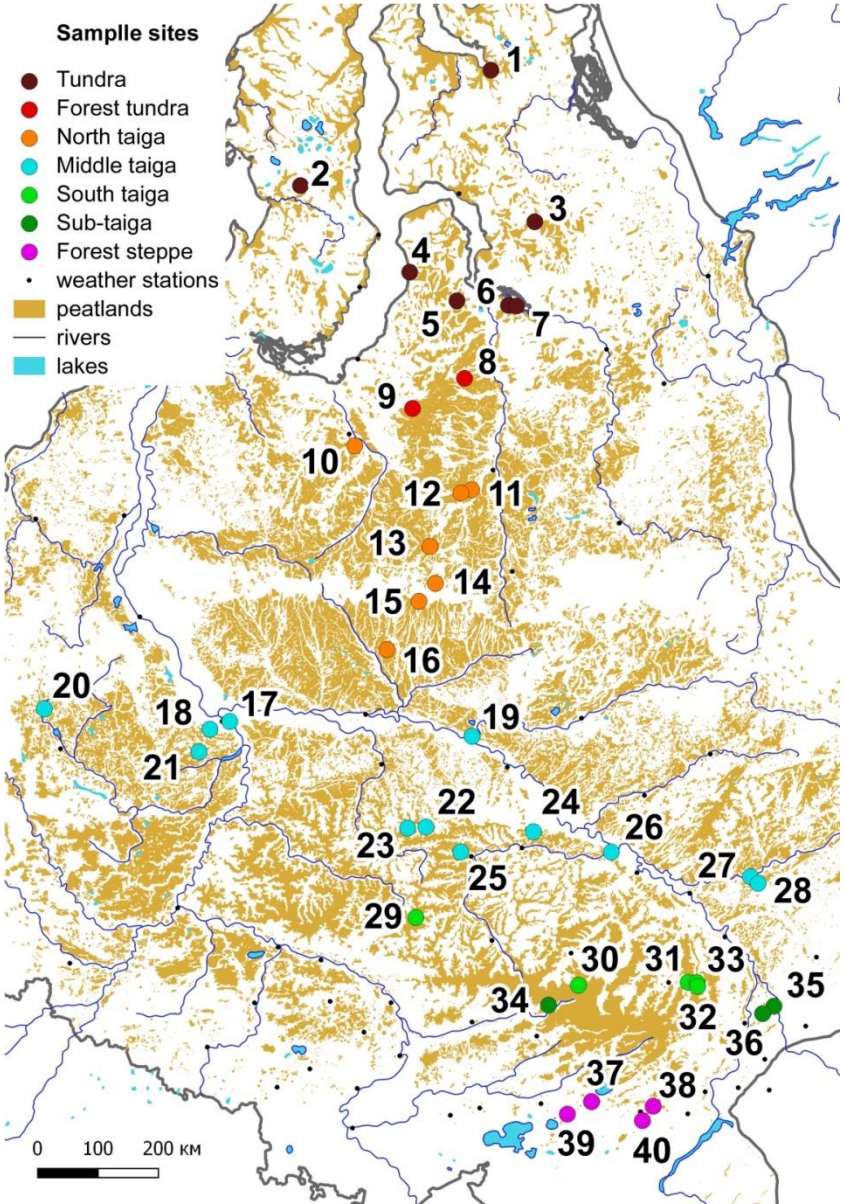
[1]Institute of Monitoring of Climatic and Ecological Systems (Tomsk)
[1,2]V.B. Sochava Institute of Geography SB RAS (Irkutsk)

ESTIMATION OF THE INFLUENCE OF HYDROTHERMAL CONDITIONS ON THE CARBON ISOTOPE COMPOSITION IN SPHAGNUM MOSSES OF BOGS OF WESTERN SIBERIA

[1]Preis Yu. I., [1]Simonova G. V., [1,2]Voropay N.N., [1]Dyukarev E.A.

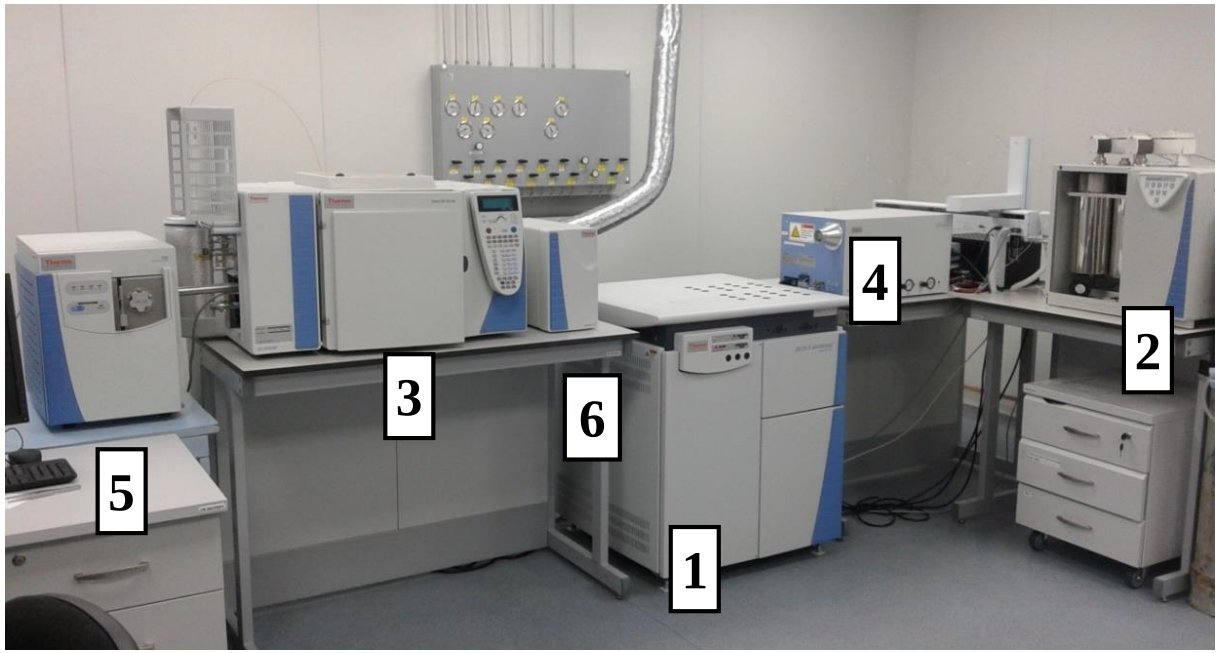
The aim of this work is estimation of the influence of hydrothermal conditions on the carbon isotope composition in sphagnum mosses of bogs of Western Siberia



Sphagnum mosses samples from oligotrophic bogs of Western Siberia along the meridian transect from the tundra to the forest-steppe were collected from 176 sites of 40 bogs.

Sampling sites map

Mass-spectrometer complex (IMCES SB RAS)



1. Isotope mass spectrometer DELTA V Advantage for determining isotope ratios (IRMS) company Thermo Fisher Scientific, Germany;
2. Elemental analyzer Flash 2000 (EA);
3. Gas chromatograph TRACE GC ULTRA interface GC IsoLink (GC);
4. GasBench II - a system study of carbonates and water samples;
5. Quadrupole mass spectrometer;
6. System timing ConFlowIV.

Samples preparation:
1. Processing by HCl 3% for carbonates removing.
2. Washing out by deionized water in ultrasonic bath.
3. Drying at 70 °C during 24 hrs.

The determination of δ13C in moss samples was carried out using the standard method using the Flash 2000 element analyzer and the DELTA V Advantage isotope mass spectrometer at the Tomsk Center for Equipment Sharing of the SB RAS.

The isotopic composition was measured with respect to the standard gas calibrated according to the cellulose standard IAEA-CH-3 (IAEA). The error of the measurement result did not exceed ± 0.2 ‰.

Sphagnum mosses

Group of *S. balticum* (aero- and subhydrophytes*)

S. balticum

S. majus
S. fallax
S. riparium

Group of *S. fuscum* (mesohydrophytes*)

S. fuscum

S. rubellum
S. capillifolium
S. fimbriatum

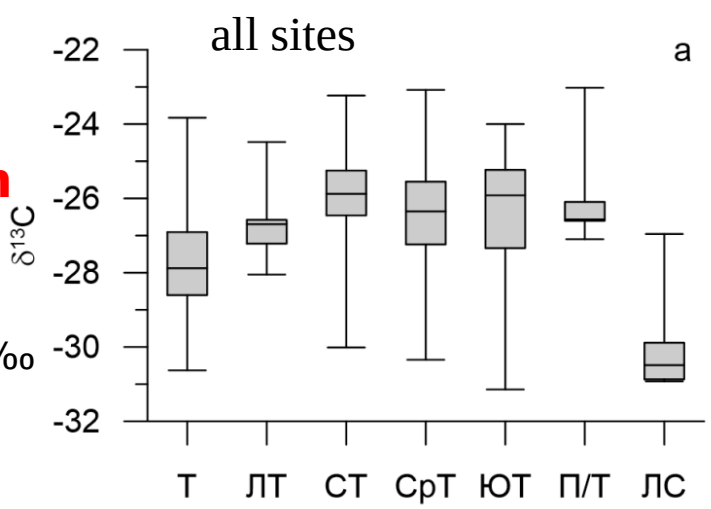
Samples of each group were divided into those selected on habitats with typical and notypical (adverse water regimes).

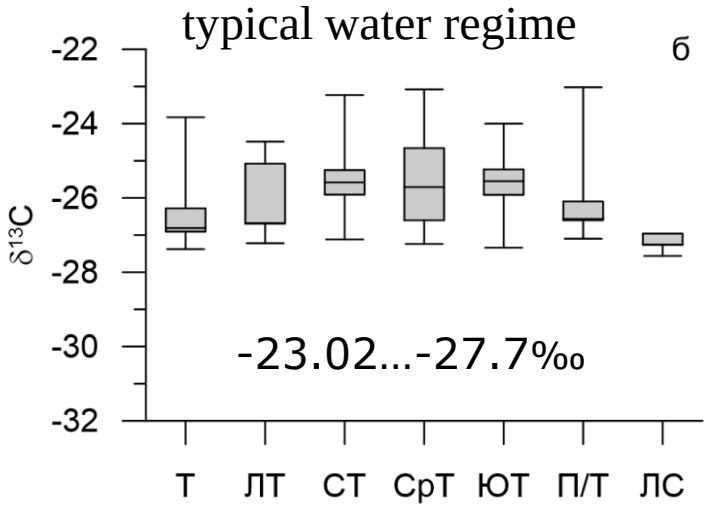
** Lapshina E.D. Flora of the bogs of the southeast of Western Siberia. 2003, 296 p.*

Isotope composition $\delta^{13}C$ of Sphagnum mosses of different Western Siberia natural-climatic zones/subzones

S. balticum

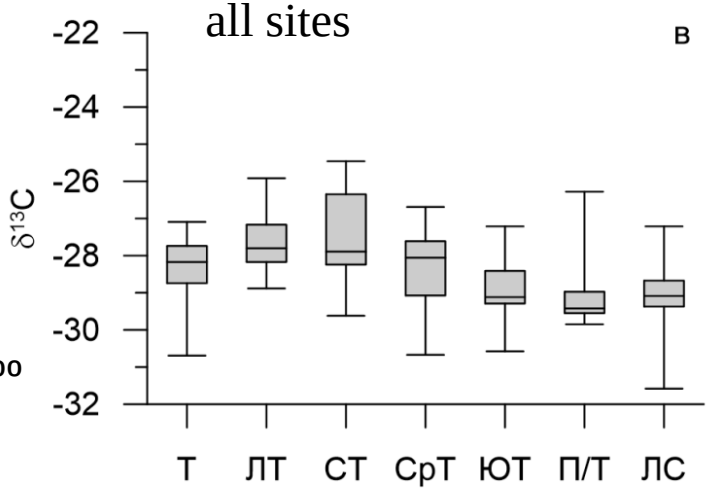
-23.1…-30.7‰

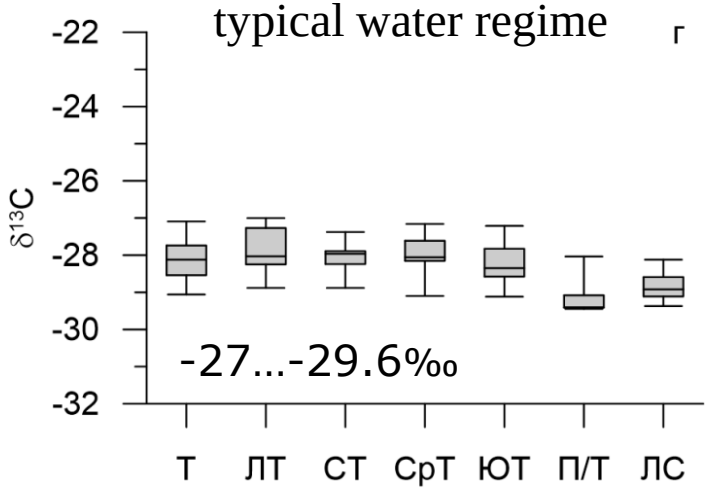




S. fuscum

-25.5…-31.6‰





Median values $\delta^{13}C$ and standard deviations for groups of mosses

Correlation coefficients between δ13C and weather parameters (2010-2013)

Weather parameters	S. balticum			S. fuscum		
	Habitats					
	All	Typical	Non typical	All	Typical	Non typical
Tveg	0.00	0.01	**-0.50**	-0.09	-0.18	-0.16
Ts10	-0.04	-0.01	**-0.51**	-0.12	-0.19	-0.21
Pyr	**0.55**	0.12	0.48	0.30	0.36	0.28
Pveg	**0.65**	0.39	0.41	0.21	0.25	0.20
Psum	**0.52**	0.38	0.35	0.18	0.31	0.08
Pwin	**0.40**	-0.05	0.36	0.30	0.31	0.28

Tyr – annual air temperature;
Tveg – May-Sep air temperature;
Tsum – Jun-Aug air tempearture;
Ts10 – sum temperature above 10 oC;
Pyr – annual precipitations;
Psum –summer precipitations (Jun-Aug);
Ps10 – precipitations at air temperature above 10 oC;
Pwin – winter precipitations (Dec-Feb).

Correlations of mean δ13C contents with Selyaninov Hydrothermal coefficient (HTC)

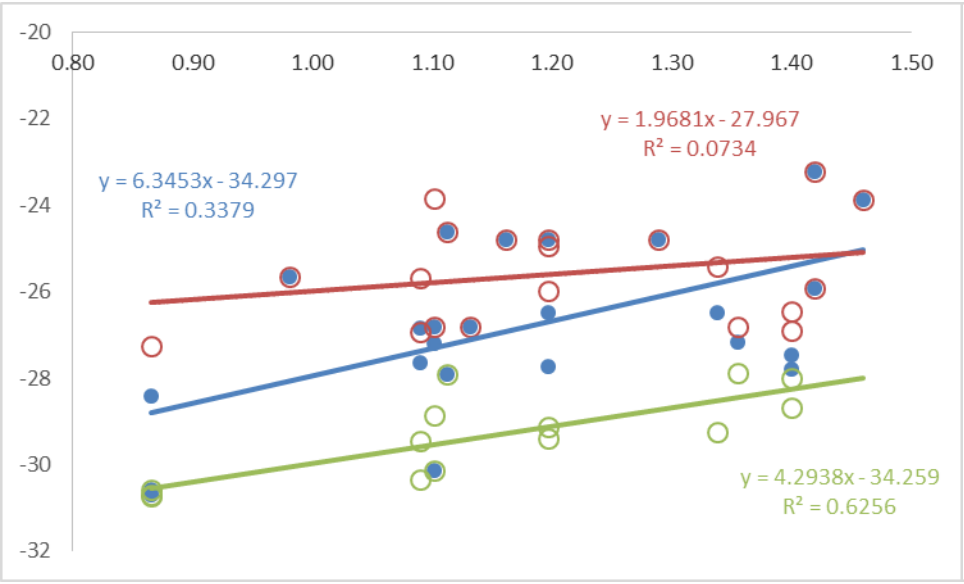
	S. balticum			S. fuscum		
	Sites					
	All	Typical	Non typical	All	Typical	Non typical
HTC 2010-2013	0.58	0.27	**0.79**	0.45	**0.53**	0.21
HTC 2000-2016	0.63	0.26	0.36	0.31	0.37	0.28
HTC 1985-2016	**0.66**	0.23	0.46	0.36	0.34	0.40

НТС (ГТК Селянинова) = 10*Ps10 / Ts10

Positive correlations of δC13 were found for the hydrothermal coefficient averaged for 2010-2013 : for the S. balticum mosses from all and from non typical habitats, and for the S. fuscum mosses from typical habitats.

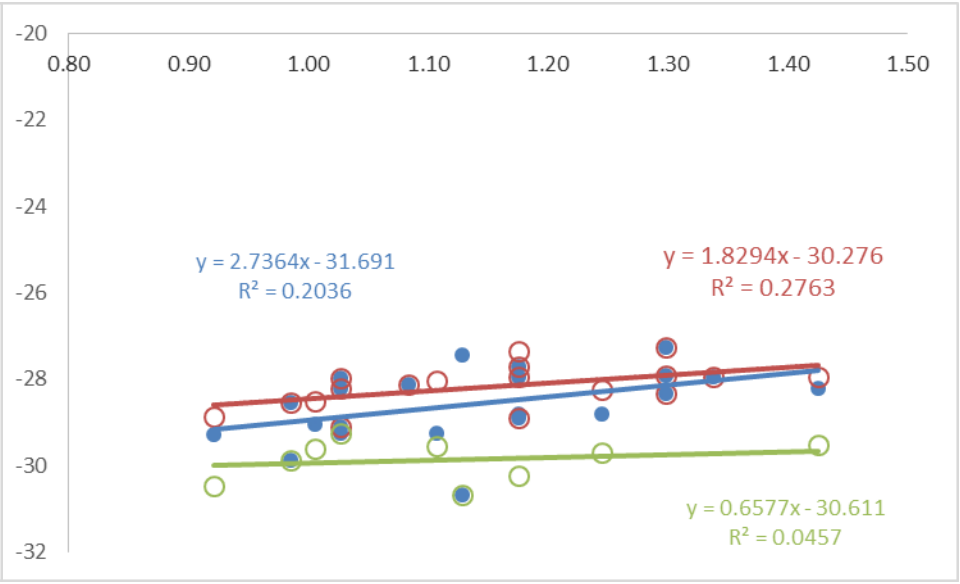
Sph. balticum

HTC



Sph. fuscum

HTC



Correlations of mean $\delta^{13}C$ with HTC (2010-2013).

Sites:
all – blue,
typical – red,
non typical – green.

$\delta^{13}C = a + b \times HTC$

Multiply linear regression model $\delta^{13}C = a + b \times Ts10 + c \times HTC + d \times Pwin$

	Sph. Balticum			Sph. Fuscum		
	All	Typical	Non Typical	All	Typical	Non Typical
a ( )	-25.56	-23.14	-28.81	-28.80	-28.30	-28.70
b (Ts10)	-0.0065	-0.0026	-0.0024	-0.0013	-0.0011	-0.0024
c (HTC)	0.0599	0.0234	0.0142	0.0098	0.0083	0.0185
d (Pwin)	-0.0618	-0.0900	0.0205	0.0154	0.0099	-0.0301
Std Err	1.38	1.11	0.85	0.83	0.49	0.50
r	**0.76**	**0.51**	**0.68**	0.33	0.43	**0.64**

A multiple linear regression model in which the sum of temperatures above 10 ° C, the hydrothermal coefficient and the sum of the precipitation of the winter period are used as predictors, makes it possible to explain from 26 to 58% (r = 0.51 ÷ 0.76) the observed variability of δ13C for all mosses and habitats, except the S. fuscum mosses from all habitats.

Conclusions

The absence or weak correlation of the δ13C composition of sphagnum mosses, both hydrophytes and mesohydrophites, of typical habitats with meteorological parameters indicates the azonal character of the vegetation of oligotrophic bogs of the West Siberian Plain and confirms the determining influence of local factors on δ13C composition of Sphagnum mosses.

Zonal features of δ13C are manifested only in mosses of S. balticum group from habitats with non typical water regimes.

The presence of links with precipitation confirms the significant effect of the moisture regime on δ13C mosses of the Sphagnum balticum group.

Extremely sensitive response to changes in local conditions of growth of hydrophytic sphagnum mosses confirms the possibility of using them for monitoring the functional state of wetlands and climate changes.

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Thank you for attention!