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Supplement of

Permafrost coverage, watershed area and season control of dissolved carbon and major elements in western Siberian rivers

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Supplement 1. Hydrological parameters of the WSL rivers

The daily, seasonal and annual discharges of some of the studied rivers are available from systematic surveys by the Hydrometeorological State Committee of the former USSR Goskomgidromet and Roskomgidromet (now the Russian Hydrological Survey, RHS). These data are published in the annual issues of the State Water Cadastre (Hydrological Yearbooks) and generalized in the "Resources of surface waters of the USSR, 1964 and 1972". Given the limited number of observation over the year, the river discharge for each river was averaged for each of the 3 seasons of sampling (May to June, July to October, and November to April). For this, we used available monthly average discharges from the RHS gauging stations in the Kara sea basin from the data base of R-AcricNET (www.r-arcticnet.sr.unh.edu), which is based on mean-multi-annual data of the RHS. The runoff contour lines in Fig 1 A are based on results of Russian Hydrological Survey gauged river monitoring in the region a summarized and compiled in Nikitin and Zemtsov (1986). The southern, permafrost-free part of western Siberia is relatively well covered by RHS stations where monthly discharges are available until 2013-2014. In contrast, the density of stations, especially on small rivers, is much lower in the northern, permafrost – affected part of WSL. However, systematic hydrological study of State Hydrological Institute in 1973-1992 in the northern part of western Siberia allowed reliable evaluation of small and medium rivers discharges (Novikov et al., 2009). In case of the RHS gauging station location which was different from our sampling point of this river, we used an interpolation of the discharge taking into account the watershed area change along the main course of the river (Methodical, 2007; Svod pravil, 2004). In the absence of the gauging station at the river, we used either an analogous river approach or mean values for the area-normalized discharge in the region, given the rather homogeneous geographical setting of WSL (see runoff distribution in Fig. 1). For small and medium rivers of the palsa and polygonal bogs of the permafrost zone, we used empirical formulas accounting for hydrological parameters of these watersheds (Novikov et al., 2009). For southern rivers of the region, in the permafrost-free zone, the annual runoff was taken from available data of the RHS in 2013-2014 and calculated for ungauged rivers using an analogous approach.

References:

Resources of Surface Waters of the USSR (eds. Zhil, I. M. and Alushkinskaya, N. M.). Vol. III, Northern regions. Gidrometeoizdat, Leningrad, 633 pp., 1972.

Resources of Surface Waters of the USSR (ed. Eirikh, G.D.). Vol. XV, Altai and Western Siberia. Issue 3: Low Irtush and Low Ob. Gidrometeoizdat, Leningrad, 432 pp., 1964.

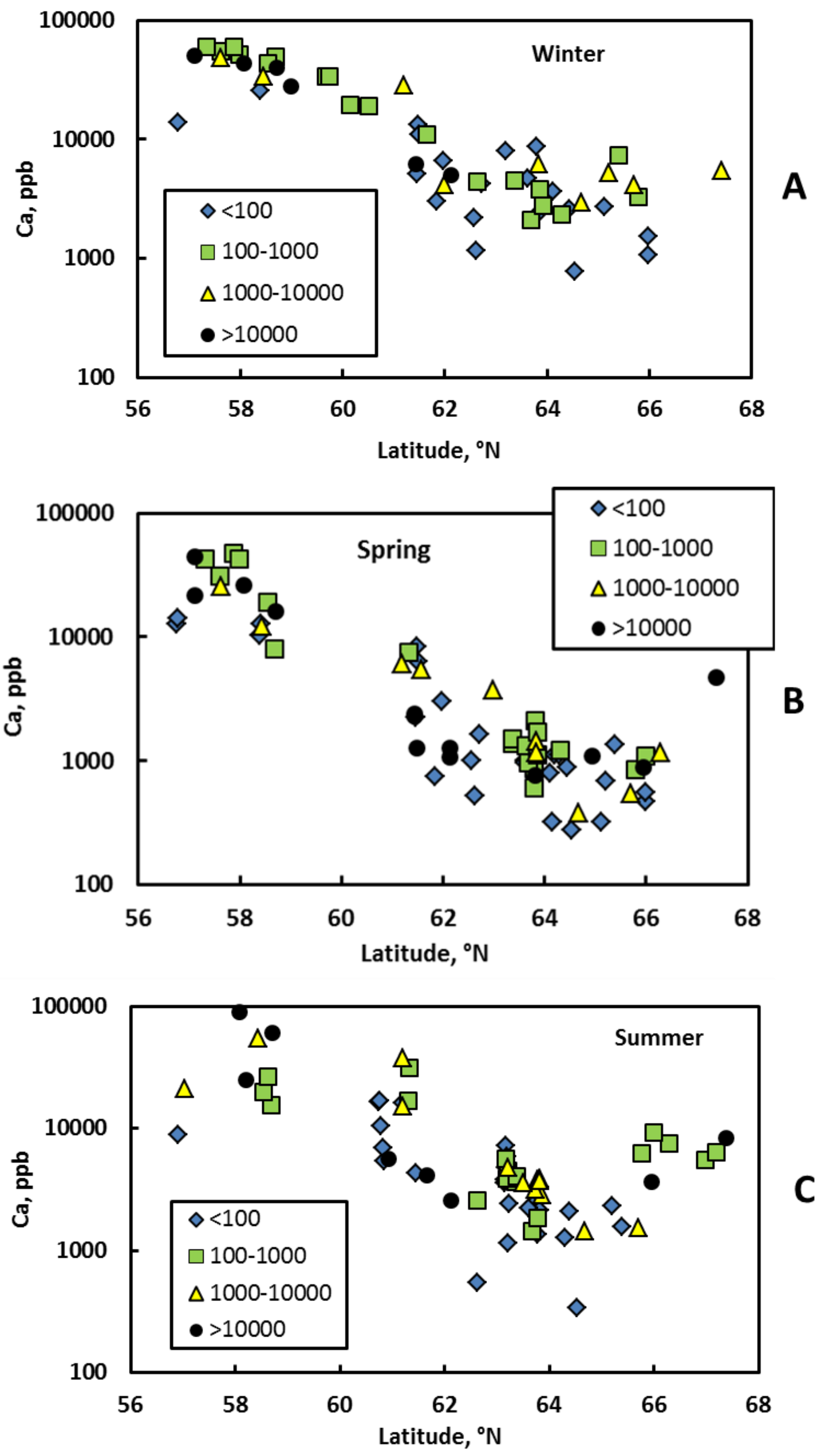


Figure S1. Significant decrease of Ca concentration in western Siberian rivers with latitude during winter (A), spring (B) and summer (C). The symbols represent different size of the watershed, see Fig. 2. Note the logarithmic scale on concentration in all three plots. The latitudinal trend is significant at $p < 0.001$.

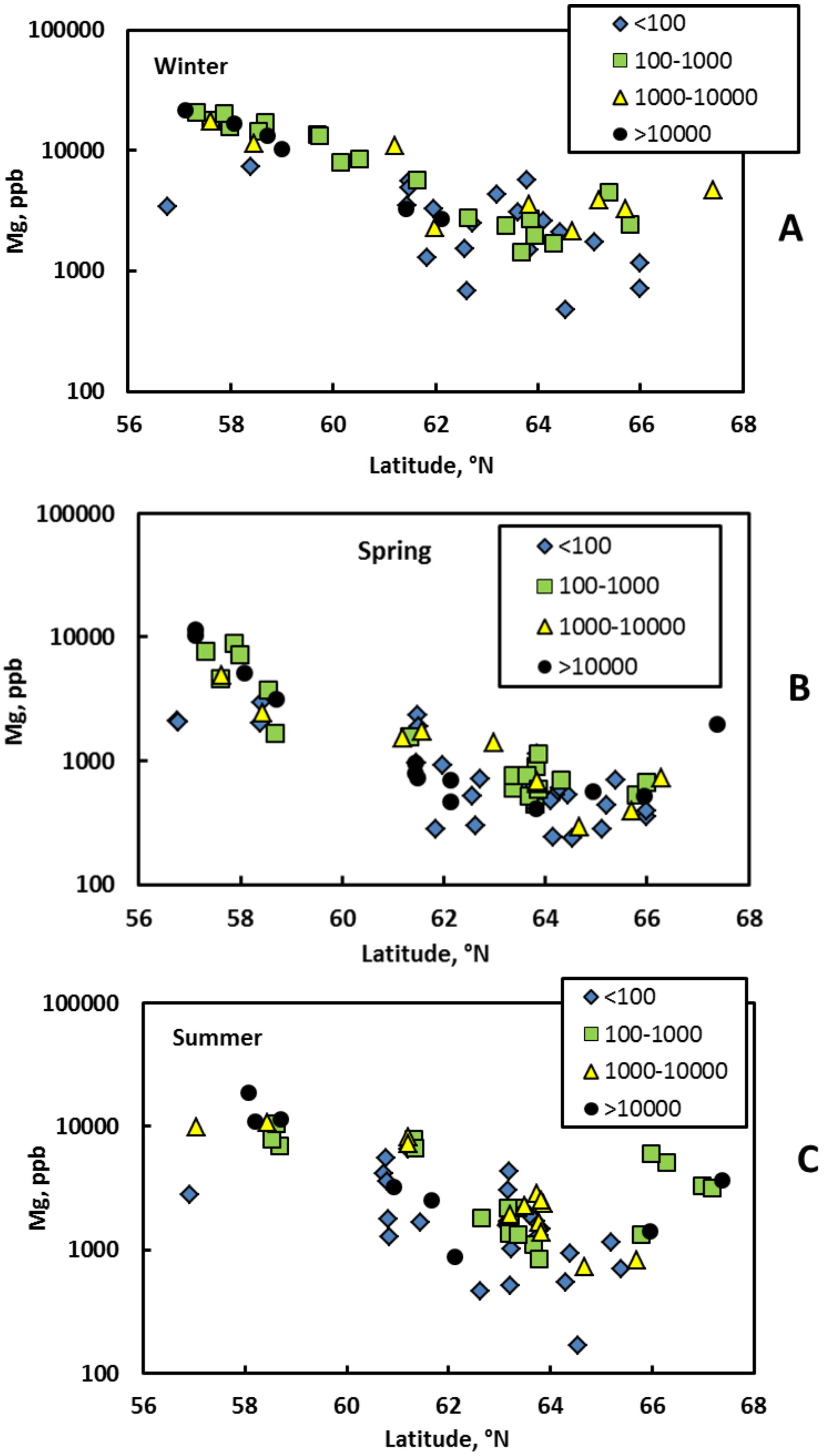


Figure S2. Significant decrease of Mg concentration in western Siberian rivers with latitude during winter (A), spring (B) and summer (C). The symbols represent different size of the watershed, see Fig. 2. Note the logarithmic scale on concentration in all three plots. The latitudinal trend is significant at $p < 0.001$.

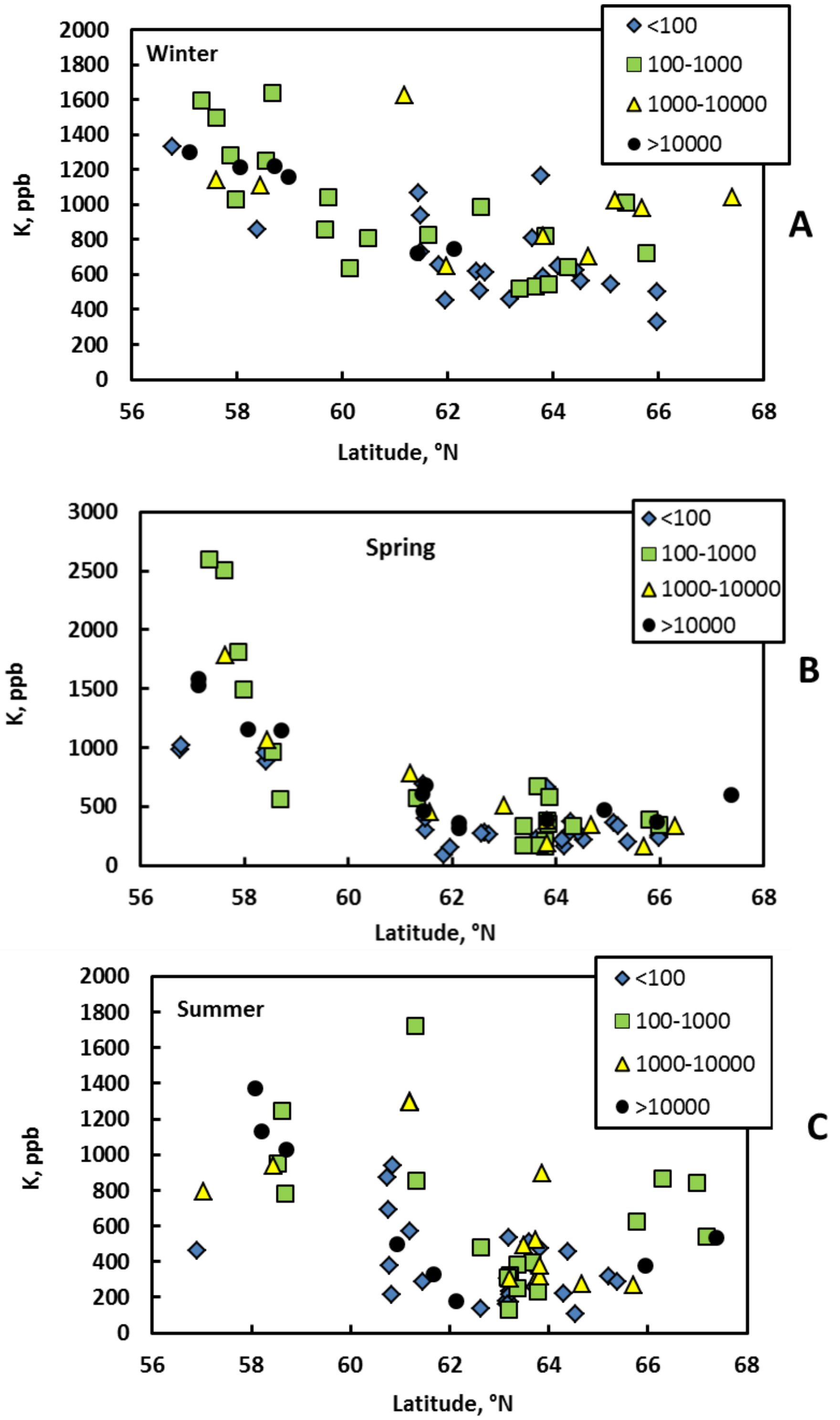


Figure S3. Evolution of K concentration in western Siberian rivers with latitude during winter (A), spring (B) and summer (C). The symbols represent different size of the watershed, see Fig. 2. The latitudinal trend is significant at $p < 0.001$.

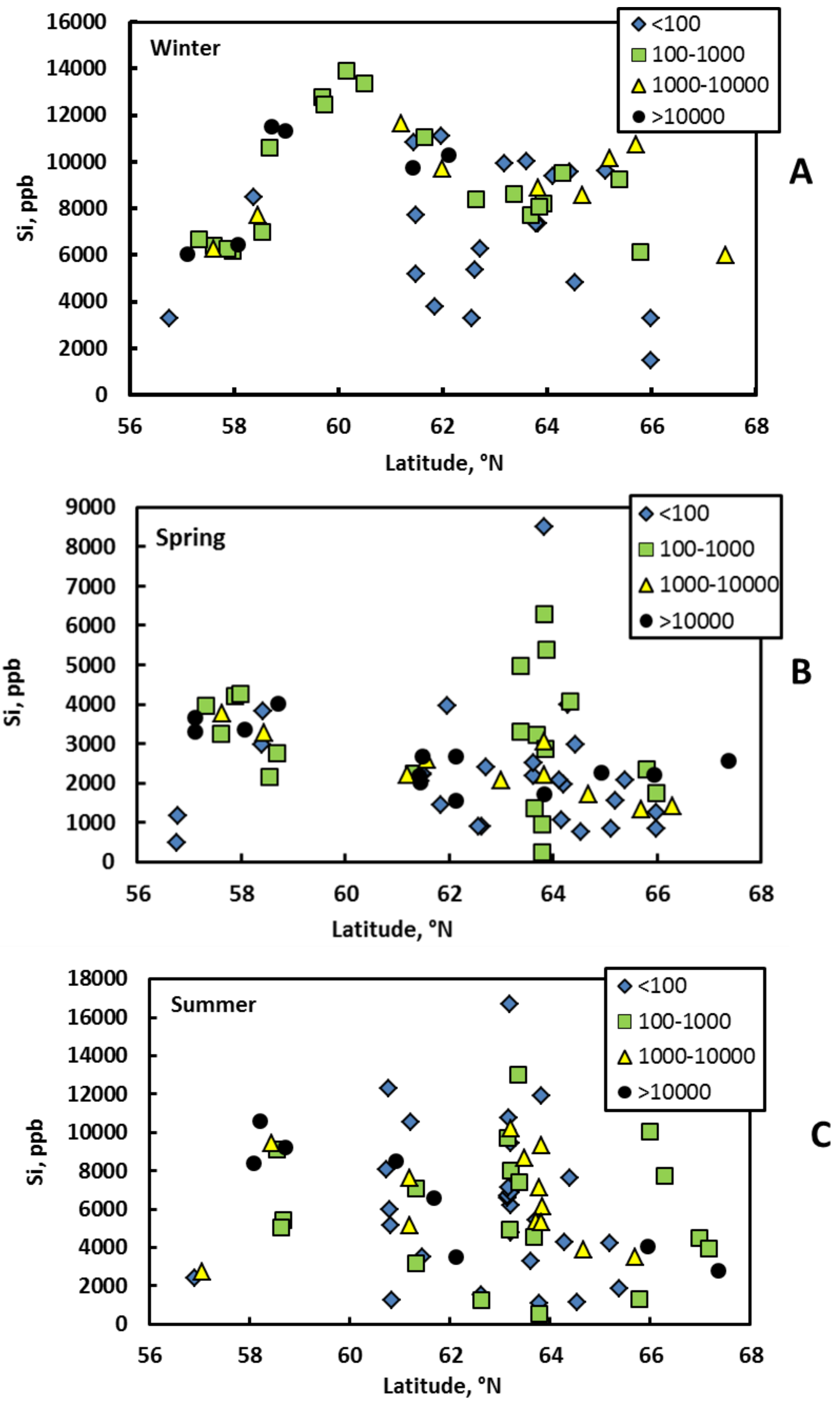


Figure S4. Evolution of Si concentration in western Siberian rivers with latitude during winter (A), spring (B) and summer (C). The symbols represent different size of the watershed, see Fig. 2.

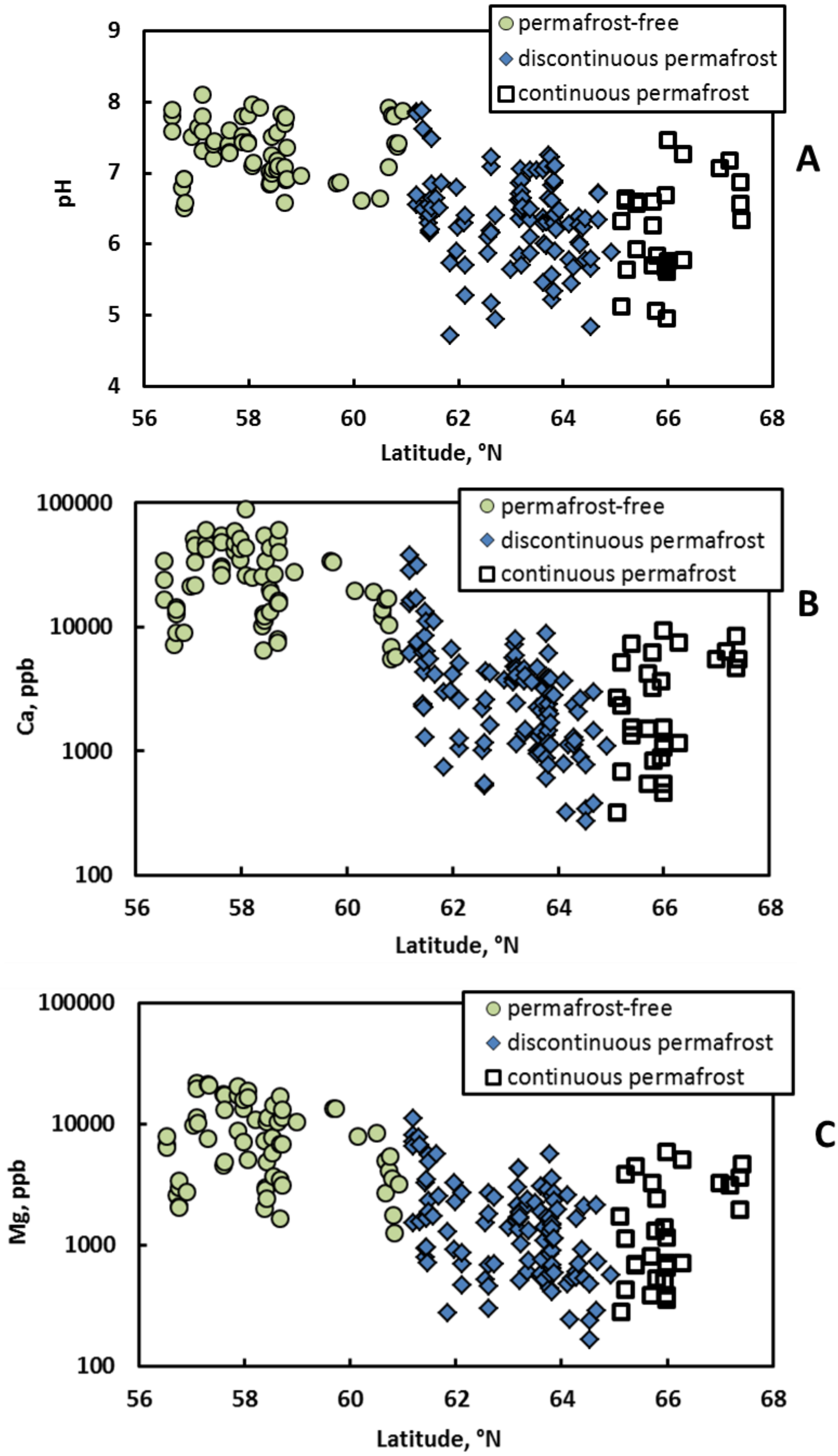


Figure S5. pH (A), Ca (B) and Mg (C) concentration in rivers as a function of latitude representing all seasons and all river watersheds. The difference between three permafrost zone are significant at $p < 0.05$. Note log scale for Ca and Mg concentration as a function of latitude.

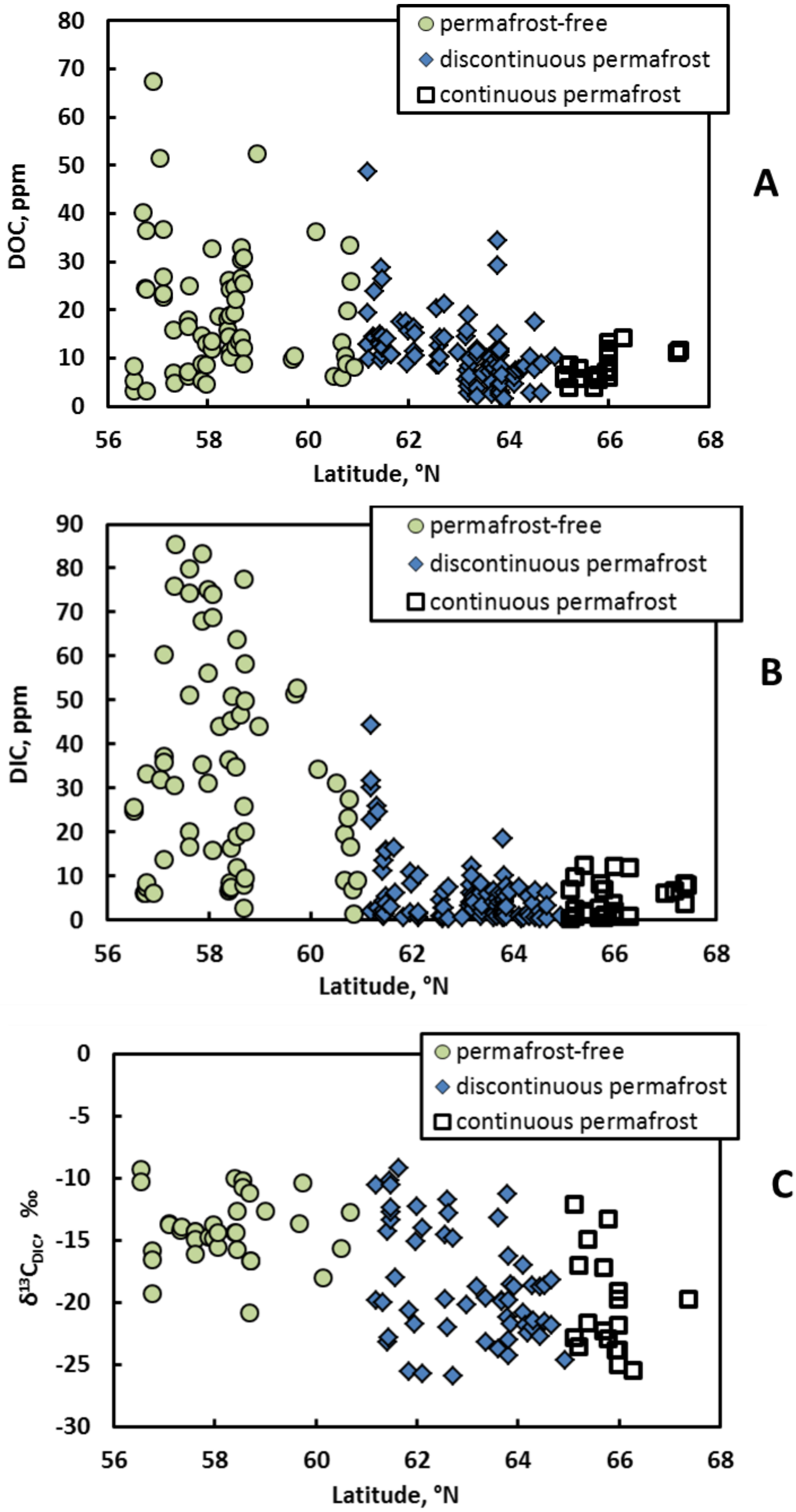


Figure S6. DOC (A), DIC (B) and $\delta^{13}C_{DIC}$ (C) of all river size as a function of latitude comprising all sampled rivers during all seasons. The differences between 3 groups of sites are significant at $p < 0.05$.

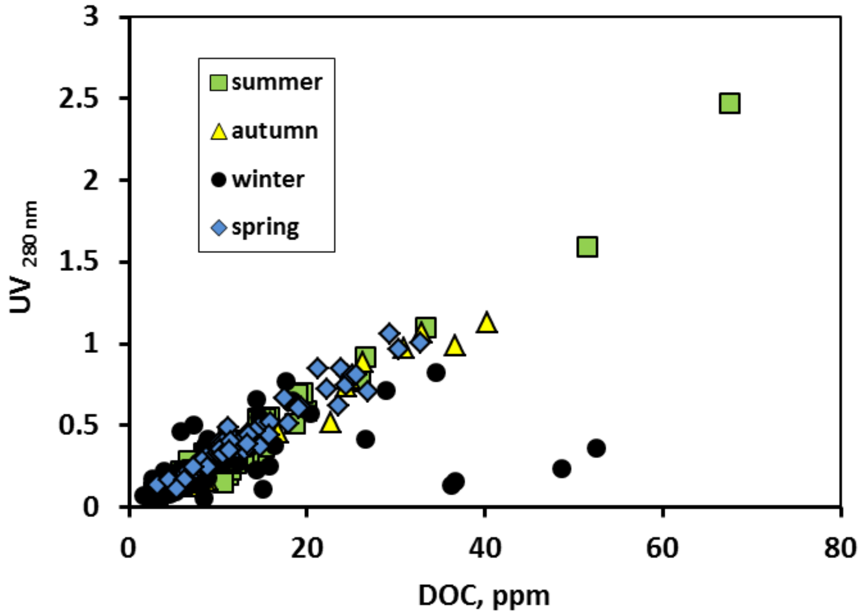
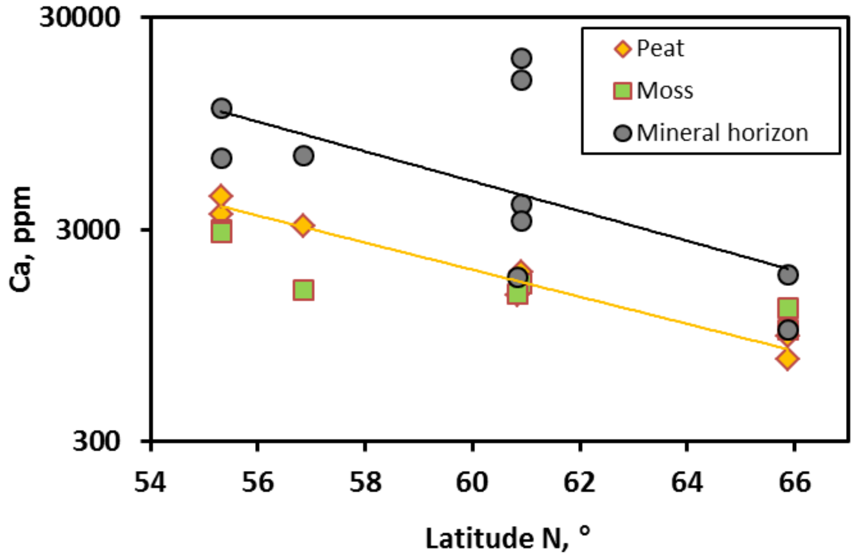


Figure S7. Universal dependence of $UV_{280\ nm}$ absorbance of DOC concentration in all rivers during all seasons except winter (black circles) where some hydrocarbon degradation products or oil-field organics may produce significant scatter.



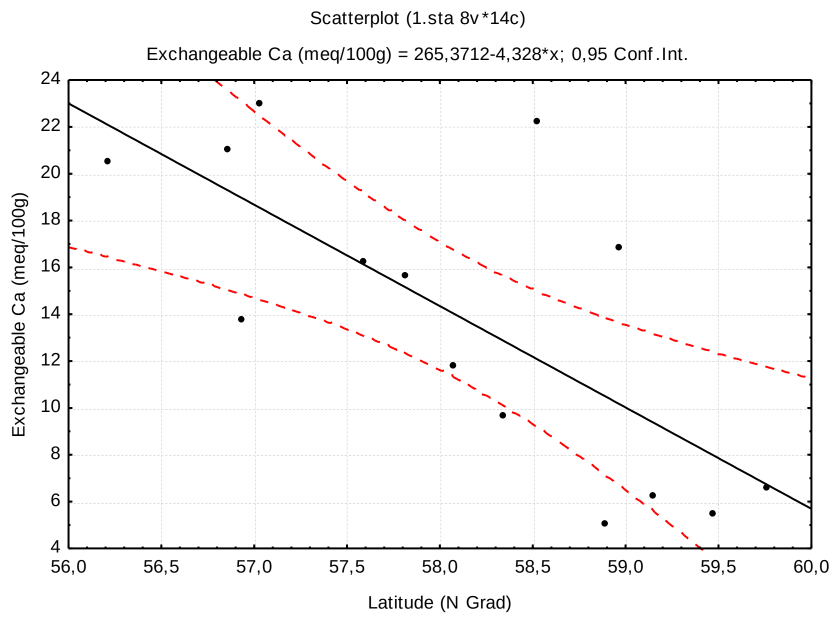


Figure S8. **A :** Latitudinal trend of Ca concentration across the WSL in peat (diamonds), moss (squares) and mineral horizon (circles) of the peat column (Stepanova et al., 2015). **B:** exchangeable Ca concentration in alluvial soils of the Ob River basin (Slavnina et al., 1981; Afanas'eva et al., 1984 and Izerskaya et al., 2014). Solid lines represent statistically significant trends at $p < 0.05$.

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Table S1. Major physical and hydro-chemical parameters of sampled rivers. See Table 1 and Fig. 1 for localization.

SPRING	Date	S, km^2	D, m3/s	O_2, % sat	R, µS cm^{-1}	pH	DIC, ppm	DOC, ppm	$UV_{280\ nm}$	Cl, ppm	SO_4, ppm	$\delta^{13}C_{DIC}$, ‰
RJ-22	29.05.2014	1.79	0.017	72.4	106	6.64	5.326	12.22	1.352	15.07	0.070	-12.7
RJ-21	29.05.2014	3.37	0.032	85.9	115	6.85	3.65	12.23	1.384	22.22	0.156	-10.5
RJ-20	29.05.2014	7.18	0.069	70.3	34	6.16	0.785	14.58	1.455	4.403	0.630	-22.8
RJ-39	31.05.2014	7.46	0.044	79	9	5.12	0.309	6.546	1.143	0.128	0.555	-22.8
RJ-2	27.05.2014	8.14	0.062	91	66	6.91	6.037	24.61	1.804	0.161	0.010	-15.8
RJ-24	29.05.2014	9.52	0.091	66.6	20	4.71	0.372	17.62	1.654	0.741	0.273	-25.5
RJ-56	07.06.2014	9.65	0.124	71.6	9	5.16	0.356	8.59	1.264	0.425	0.489	-22
RJ-40	31.05.2014	12.04	0.070	72	10	5.63	0.6474	8.585	1.27	0.150	0.581	-23.5
RJ-12	27.05.2014	12.25	0.400	68.5	84	6.86	8.409	14.54	1.462	0.411	0.957	-14.4
RJ-36	30.05.2014	15.19	0.146	77.5	12	4.83	0.2915	7.684	1.188	0.222	0.381	-21.5
RJ-31	30.05.2014	18.8	0.180	61.3	8	5.43	0.3335	7.346	1.181	0.082	0.267	-21.8
RJ-25	29.05.2014	21.55	0.207	76.3	39	5.91	1.433	17.5	1.677	4.35	0.327	-21.7
RJ-55	07.06.2014	23.95	0.309	60.1	30	4.94	0.3504	21.22	1.876	3.480	0.364	-25.9
RJ-57	07.06.2014	33.48	0.432	75.1	12	5.86	0.638	8.557	1.244	0.466	0.366	-19.7
RJ-52	07.06.2014	34.61	0.447	65.3	19	5.46	0.575	10.18	1.38	2.268	0.370	-23.7
R-4	10.06.2013	34.61	0.447	79	n.d.	6.3	1.461	8.70	0.29	2.366	2.095	n.d.
RJ-46	02.06.2014	39.88	0.233	72.8	10	4.95	0.882	7.57	1.2	0.142	0.626	-23.8
RJ-45	02.06.2014	42.39	0.248	78.2	9	5.61	0.756	6.13	1.155	0.180	0.602	-21.8
RJ-35	30.05.2014	46.4	0.599	67.9	11	5.78	0.483	10.2	1.365	0.0889	0.230	-22.7
RJ-11	27.05.2014	58.56	1.913	59.3	67	7.02	6.611	15.9	1.484	0.251	0.182	-14.4
RJ-32	30.05.2014	59.86	0.772	68.1	39	5.68	0.591	7.63	1.235	8.13	0.276	-22.4
RJ-3	27.05.2014	61.48	0.775	73	76	6.91	7.275	24.4	1.758	0.106	0.0181	-16.5
RJ-30	30.05.2014	67.06	0.865	67.2	10	5.78	0.6641	6.10	1.142	0.076	0.248	-20.8
RJ-33	30.05.2014	71.61	0.924	62.8	28	6.02	1.053	7.99	1.259	3.754	0.329	-22
R-3	10.06.2013	74	0.955	65	n.d.	6.3	3.201	3.20	0.134	7.879	2.439	n.d.
RJ-50	07.06.2014	74	0.54	60.7	29	6.37	1.835	4.57	1.142	1.830	1.367	-23
RJ-41	31.05.2014	78.94	0.461	63.9	15	5.92	1.173	7.93	1.26	0.165	0.455	-21.6
RJ-34	30.05.2014	105.08	1.58	60.7	16	5.99	0.867	8.29	1.288	0.465	0.387	-21.4
RJ-43	31.05.2014	106.16	0.724	67.6	14	5.84	0.951	6.45	1.215	0.704	0.954	-22.9
RJ-27	30.05.2014	115.39	1.86	64.7	10	5.56	0.581	8.64	1.276	0.136	0.353	-21.2
Z-86	07.06.2013	115.39	1.86	82	13	5.22	1.067	29.25	0.2357	0.232	0.328	n.d.
RJ-58	11.06.2014	116.88	6.93	66.2	46	6.59	2.615	30.36	1.988	0.0583	1.168	-20.8
RJ-53	07.06.2014	175.29	2.64	70.7	16	5.86	0.707	11.83	1.41	0.469	0.6014	-23.2
R-5	10.06.2013	175.29	5.33	64	n.d.	6.1	1.774	10.53	0.391	4.71	1.178	n.d.
RJ-8	27.05.2014	177.45	3.16	68.3	286	7.53	35.34	14.82	1.351	0.345	0.1735	n.d.
RJ-9	27.05.2014	275.16	3.52	64.1	258	7.44	30.95	13.01	1.319	0.256	0.2606	-13.7
RJ-51	07.06.2014	280.59	1.32	61.6	13	5.97	0.687	8.69	1.293	0.577	0.4154	-19.8
RJ-6	27.05.2014	302.46	3.81	75.4	179	7.40	19.95	17.97	1.504	0.265	0.5110	-14.3
RJ-5	27.05.2014	320.04	6.15	83.1	256	7.40	30.6	15.82	1.419	0.3019	0.176	-14.2
RJ-18	29.05.2014	359.31	5.17	71.5	118	6.49	2.598	23.8	1.874	22.46	0.4025	-20
RJ-49	04.06.2014	512.33	4.24	78.4	15	5.76	0.6836	13.24	1.447	0.3160	0.667	-25
R-6	10.06.2013	598	11.6	80	n.d.	6.0	1.298	9.948	0.33	1.379	8.258	n.d.
RJ-54	07.06.2014	598	25.8	67.6	156	5.64	0.598	11.17	1.472	40.92	0.123	-20.2
RJ-14	27.05.2014	689	22.5	84.2	112	7.11	11.88	22.31	1.707	0.1145	0.0907	-10.7
R-2	10.06.2013	820.66	9.56	66	n.d.	6.2	2.786	6.606	0.2215	4.815	7.077	n.d.
RJ-29	30.05.2014	820.66	9.56	67.2	32	5.90	0.752	8.247	1.26	5.358	0.4519	-21.7
RJ-7	27.05.2014	1020.47	13.8	57.5	151	7.28	16.47	25.1	1.827	0.2299	0.4997	-16.1
RJ-23	29.05.2014	1260	9.10	72.5	132	6.64	2.976	13.95	1.455	27.31	0.4227	-18
RJ-48	04.06.2014	1970	16.3	77.7	14	5.78	0.675	14.24	1.479	0.1563	0.5026	-25.4
RJ-17	29.05.2014	3190	51.0	109	94	6.56	1.908	19.33	1.611	17.61	0.8858	-19.8
RJ-13	27.05.2014	3460	113	65.5	75	7.25	7.262	19.04	1.591	0.2680	0.5762	-15.7
RJ-42	31.05.2014	4030	44.5	77.5	10	5.70	0.596	6.215	1.17	0.1947	0.6968	-22.3
RJ-37	30.05.2014	5110	68.5	64.7	13	6.72	0.2806	8.776	1.221	0.6556	0.3655	-21.8
Z-55	05.06.2013	9881	134	n.d.	n.d.	n.d.	1.265	11.17	0.374	2.046	0.7693	n.d.
R-1	10.06.2013	9881	134	76	29	6.4	1.498	11.61	0.357	2.915	3.297	n.d.
RJ-28	30.05.2014	9881	134	79.1	17	5.33	0.456	10.55	1.316	1.676	0.3923	-24.3
R-7	10.06.2013	10768	154	79	n.d.	5.7	1.288	10.42	0.331	2.304	1.329	n.d.
R-8	10.06.2013	10768	367	68	31	6.2	1.249	10.82	0.330	2.340	3.904	n.d.
RJ-26	29.05.2014	10768	154	81.1	14	5.27	0.5529	11.39	1.393	0.5485	0.4622	-25.7
RJ-4	27.05.2014	12000	122	58.5	334	7.58	37.25	23.48	1.609	4.799	6.361	-13.7
R-10	12.06.2013	12000	121	67	347	8.1	35.73	26.86	0.709	2.870	7.046	n.d.
RJ-15	27.05.2014	25500	403	72.3	99	6.89	9.555	25.59	1.825	0.6347	0.958	-16.6
RJ-38	31.05.2014	26100	350	83.5	15	5.89	0.8026	10.34	1.362	0.2963	0.703	-24.6
RJ-10	27.05.2014	27200	348	58.1	159	7.11	15.68	32.75	2.024	1.572	1.88	-15.5
R-9	12.06.2013	27622	475	61	42	6.3	2.028	12.86	0.415	1.890	5.60	n.d.
RJ-19	29.05.2014	27622	475	8.04	33	6.37	1.107	13.45	1.445	4.552	0.730	-23.2
RJ-44	31.05.2014	112000	888	79.3	15	5.67	0.8375	7.288	1.231	0.955	0.886	-23.8
RJ-47	04.06.2014	150000	1286	79.6	43	6.87	3.739	11.27	1.37	0.319	1.03	-19.7
RJ-1	27.05.2014	423100	n.d.	181	242	7.90	24.8	5.449	1.056	2.393	13.7	-9.3
RJ-16	29.05.2014	773200	n.d.	95.2	99	7.09	9.034	13.25	1.384	1.167	4.933	-12.7

Table S1, continued.

SUMMER	Date	S, km^2	D, m3/s	O_2, % sat	R, $\mu S\ cm^{-1}$	pH	DIC, ppm	DOC, ppm	$UV_{280\ nm}$	Cl, ppm	SO_4, ppm
BL-35	22.08.2013	7	0.035	n.d.	n.d.	7.81	23.22	10.44	0.2409	5.98	5.20
RA-18	08.08.2014	7.18	0.061	n.d.	52	6.42	4.253	9.481	1.268	2.90	0.341
BL-28	22.08.2013	9.35	0.080	n.d.	n.d.	7.83	31.51	9.830	0.3644	4.556	1.30
BL-25	22.08.2013	9.65	0.16	n.d.	n.d.	7.08	0.659	10.47	0.1796	1.009	0.283
RA-6	03.08.2014	11	0.10	n.d.	12.6	5.7	n.d.	n.d.	1.21	0.170	0.430
RY 14-45	24.08.2014	12.04	0.11	82.8	47	6.65	2.266	5.851	1.181	0.436	0.855
RA-5	03.08.2014	15	0.14	n.d.	31.9	6.48	4.114	8.410	1.291	0.1725	0.206
RY 14-47	24.08.2014	15.19	0.14	88.7	9	5.66	0.551	61.49	1.225	0.258	0.369
RA-12	04.08.2014	19	0.18	n.d.	29	5.84	n.d.	n.d.	1.678	0.177	0.063
BL-23	21.08.2013	23.95	0.38	n.d.	n.d.	7.25	3.827	7.813	0.277	4.276	3.28
BL-34	22.08.2013	26	0.130	n.d.	n.d.	7.80	27.27	8.842	0.3492	9.43	5.13
BL-31	22.08.2013	31	0.155	n.d.	n.d.	7.42	1.277	25.98	0.769	2.243	39.9
BL-3	12.08.2013	32	0.185	n.d.	n.d.	7.51	6.003	67.53	2.474	3.673	0.1393
BL-33	22.08.2013	32	0.160	n.d.	n.d.	7.42	16.66	19.88	0.594	2.977	0.5419
RA-15	04.08.2014	32	0.30	n.d.	26.3	6.62	3.123	14.47	1.51	0.133	0.208
BL-19	21.08.2013	34.61	0.76	n.d.	n.d.	7.03	3.902	8.519	0.3025	4.9	4.729
RA-9	03.08.2014	43	0.40	n.d.	19.5	6.52	n.d.	n.d.	1.185	0.4350	0.267
BL-32	22.08.2013	44	0.22	n.d.	n.d.	7.37	6.797	33.40	1.1032	2.054	0.250
RY 14-48	24.08.2014	53	0.49	73.5	34	6.24	3.779	4.349	1.073	0.3571	0.638
RY 14-49	24.08.2014	71.61	0.66	68.7	43	6.26	1.657	9.692	1.192	4.7540	0.500
BL-17	21.08.2013	74	0.54	n.d.	n.d.	7.09	3.808	2.828	0.092	8.544	2.679
RY 14-44	24.08.2014	78.94	0.73	65.5	22	6.6	1.689	7.930	1.194	0.627	0.177
RA-4	03.08.2014	79.5	0.74	n.d.	54	6.85	7.893	7.527	1.218	0.1963	0.113
BL-22	21.08.2013	82	0.76	n.d.	n.d.	7.06	9.972	4.130	0.102	11.75	7.22
RA-10	03.08.2014	88	0.82	n.d.	29.9	6.64	4.002	9.859	n.d.	0.136	0.345
RA-13	04.08.2014	96	0.89	n.d.	31.5	6.35	3.831	15.75	1.529	0.330	0.080
BL-14	21.08.2013	115.39	0.60	n.d.	n.d.	6.82	2.273	11.99	0.345	0.644	0.192
RA-1	30.07.2014	115.39	1.07	n.d.	19	6.36	1.186	14.87	1.462	0.143	0.238
BL-5	03.08.2014	116.88	1.04	n.d.	n.d.	7.75	25.81	26.57	0.916	4.314	0.147
RA-8	03.08.2014	121	1.12	n.d.	34.9	6.73	5.046	6.338	1.175	0.115	0.373
RT2 14-30	21.08.2014	157	1.74	89.3	82	7.07	5.965	11.15	1.171	5.49	2.65
RA-11	04.08.2014	170	1.67	n.d.	42.1	6.71	6.062	5.603	1.145	0.658	0.394
BL-21	21.08.2013	175.29	2.87	n.d.	n.d.	7.05	6.102	3.620	0.1015	9.54	3.895
RA-16	08.08.2014	175.29	3.04	n.d.	42	6.49	3.220	11.35	1.387	1.87	0.478
RY 14-42	24.08.2014	183	1.79	77.5	11	5.06	0.499	6.655	1.267	0.321	0.2626
RA-14	04.08.2014	250	2.45	n.d.	32	6.47	2.250	18.95	1.659	3.311	0.2070
BL-18	21.08.2013	280.59	0.81	n.d.	n.d.	7.09	3.003	4.844	0.158	6.973	1.2247
BL-27	22.08.2013	359.31	5.97	n.d.	n.d.	7.88	25.83	14.39	0.5274	4.84	59.2
RA-19	08.08.2014	359.31	4.35	n.d.	293	7.62	24.52	14.14	1.427	23.4	0.164
BL-9	12.08.2013	473	2.32	n.d.	n.d.	7.57	34.65	19.45	0.7005	7.197	0.1424
BL-6	12.08.2013	510	2.50	n.d.	n.d.	7.83	46.62	13.45	0.3092	7.602	0.183
RT2 14-32	21.08.2014	512.33	8.77	110.3	173	7.46	12.17	6.169	1.119	13.69	2.16
BL-24	21.08.2013	598	7.33	n.d.	n.d.	7.22	2.652	10.25	0.3152	1.999	16.97
RT2 14-29	21.08.2014	656	10.4	83	81	7.18	6.506	10.10	1.182	4.34	2.01
BL-16	21.08.2013	820.66	10.2	n.d.	n.d.	7.10	5.348	4.553	0.1486	9.134	7.36
BL-13	21.08.2013	1396	11.5	n.d.	n.d.	6.65	6.012	9.465	0.283	3.928	0.662
RT2 14-31	21.08.2014	1970	6.97	97.4	138	7.26	11.80	15.19	1.322	9.3048	1.371
RA-3	03.08.2014	1979	40.7	n.d.	39	7.22	n.d.	n.d.	1.236	n.d.	n.d.
RA-7	03.08.2014	1979	2.33	n.d.	36.2	6.88	5.446	5.072	1.128	0.105	0.265
BL-29	22.08.2013	3190	45.4	n.d.	n.d.	7.87	29.97	12.87	0.317	4.234	10.54
RA-20	08.08.2014	3190	45.4	n.d.	n.d.	n.d.	22.70	12.80	1.365	107.2	0.296
BL-2	12.08.2013	3197	2.92	n.d.	n.d.	7.65	31.99	51.58	1.591	4.206	2.52
RA-22	08.08.2014	3460	17.0	n.d.	369	7.51	45.23	11.39	1.196	0.328	0.146
RY 14-43	24.08.2014	4030	58	90	32	6.6	2.674	7.196	1.081	0.739	1.096
RY 14-46	24.08.2014	5110	73	90.5	36	6.71	3.190	6.297	1.158	0.779	0.113
RA-2	02.08.2014	9881	142	n.d.	50	6.89	3.179	11.96	1.378	4.568	0.318
BL-20	21.08.2013	9881	60	n.d.	n.d.	7.03	5.835	6.681	0.219	6.46	6.101
BL-15	21.08.2013	9881	142	n.d.	n.d.	6.86	5.930	7.093	0.232	7.02	4.17
RA-17	08.08.2014	10768	120	n.d.	27	6.4	1.498	15.26	1.512	1.70	0.269
BL-4	12.08.2013	25500	73.5	n.d.	n.d.	7.92	43.97	18.59	0.513	8.05	1.84
RA-21	08.08.2014	25500	107	n.d.	406	7.78	49.93	12.09	1.261	1.62	0.811
RA-23	08.08.2014	27200	72.4	n.d.	610	7.96	74.16	12.01	1.237	10.06	1.23
BL-26	22.08.2013	27622	408	n.d.	n.d.	6.86	6.109	10.82	0.287	2.77	2.97
BL-30	22.08.2013	75090	1425	n.d.	n.d.	7.87	8.809	8.062	0.217	3.35	0.310
RY 14-41	24.08.2014	112000	1168	93.3	45	6.69	3.777	71.21	1.111	1.29	0.408
RT2 14-40	16.08.2014	150000	3977	n.d.	80	6.57	8.197	11.45	1.154	0.581	0.743
BL-36	22.08.2013	773200	n.d.	n.d.	n.d.	7.92	19.57	5.974	0.143	2.295	1.51

Table S1, continued.

AUTUMN	Date	S, km^2	D, m3/s	O_2, % sat	R, µS cm^{-1}	pH	DIC, ppm	DOC, ppm	$UV_{280\ nm}$	Cl, ppm	SO_4, ppm	$\delta^{13}C_{DIC}$, ‰
R-2	18.10.2013	8.14	0.0074	93.9	35	6.8	5.951	40.2	1.132	1.462	0.877	n.d.
R-12	18.10.2013	12.25	0.050	88	n.d.	6.9	7.173	26.25	0.888	3.983	0.607	n.d.
R-3	18.10.2013	61.48	0.060	86.9	37	6.5	8.496	36.6	0.9873	2.024	0.458	n.d.
R-15	18.10.2013	116.88	0.19	93.1	25	7.7	7.835	32.94	1.068	4.183	0.591	n.d.
R-8	18.10.2013	177.45	0.23	99.5	199	7.8	67.88	8.775	0.1674	6.083	0.916	n.d.
R-9	18.10.2013	275.16	0.25	93.4	170	7.82	56.04	8.528	0.1585	6.294	0.53	n.d.
R-5	18.10.2013	320.04	0.44	95.3	239	7.2	75.92	7.056	0.1235	7.107	0.640	n.d.
R-14	18.10.2013	689	2.10	106	58	7.06	19.03	24.86	0.790	4.217	0.455	n.d.
R-7	18.10.2013	1020.47	0.99	100	158	7.6	51.2	16.7	0.459	6.20	0.614	n.d.
R-13	18.10.2013	3460	15.4	84.2	87	7	16.34	24.37	0.7399	4.929	0.411	n.d.
R-4	18.10.2013	12000	7.60	98	212	7.8	60.4	22.75	0.521	5.236	8.61	n.d.
R-17	18.10.2013	25500	66.9	84.4	72	7.36	20.09	30.96	0.9709	5.227	1.71	n.d.
R-1	18.10.2013	423100	n.d.	85.4	95	7.8	24.92	3.284	0.0712	n.d.	2.40	n.d.
WINTER												
RF13	22.02.2014	1.79	0.057	n.d.	270	7.48	15.72	14.57	0.554	37.0	0.168	-13.4
RF54	03.03.2014	3.37	0.059	n.d.	239	6.51	15.44	26.51	0.417	29.26	0.616	-12.4
RF55	03.03.2014	7.18	0.034	n.d.	112	6.18	13.36	28.85	0.717	2.77	0.769	-10.2
RF31	26.02.2014	7.46	0.054	n.d.	70	6.33	6.704	5.853	0.463	0.234	0.155	-12.1
RF52	03.03.2014	9.52	0.018	n.d.	79	5.73	n.d.	n.d.	n.d.	n.d.	n.d.	-20.6
RF48	03.03.2014	9.65	0.04	n.d.	28	6.19	2.68	12.65	0.340	0.411	0.438	-11.7
RF30	26.02.2014	12.04	9.80	n.d.	105	6.62	9.603	3.904	0.07	0.499	1.86	-17
RF33	26.02.2014	15.19	0.09	n.d.	32	5.79	1.716	17.57	0.771	0.658	0.947	-18.6
RF14	22.02.2014	21.55	0.103	n.d.	112	6.80	10.73	8.86	0.4158	5.36	0.607	-15.1
RF46	03.03.2014	23.95	0.10	n.d.	91	6.40	7.229	14.14	0.411	7.23	0.295	-14.8
RF49	03.03.2014	33.48	0.06	n.d.	45	6.09	4.433	20.34	0.578	0.469	0.610	-14.5
RF39	27.02.2014	34.61	0.07	n.d.	111	6.37	6.531	7.197	0.5068	4.625	0.261	-13.2
RF26	25.02.2014	39.88	0.094	n.d.	25	5.70	1.848	10.96	0.4798	0.529	0.954	-19.1
RF25	25.02.2014	42.39	0.162	n.d.	33	5.66	1.82	12	0.3275	1.424	1.335	-19.7
RF34	26.02.2014	46.4	0.10	n.d.	56	6.35	6.506	2.709	0.1774	0.406	0.982	-18.7
RF10	19.02.2014	58.56	0.05	n.d.	329	6.84	36.23	18.34	1.6655	0.374	0.205	-10
RF2	19.02.2014	61.48	n.d.	n.d.	144	6.58	33.13	3.185	1.0453	1.201	0.343	-19.3
RF36	26.02.2014	67.06	0.08	n.d.	69	6.28	7.419	4.643	0.095	0.1643	0.105	-17
RF35	26.02.2014	71.61	0.27	n.d.	59	6.38	5.134	8.08	0.1311	3.463	0.725	-18.6
RF41	27.02.2014	74	0.14	n.d.	53	6.40	4.456	2.291	0.0484	2.85	1.43	-19.8
RF29	26.02.2014	78.94	0.34	n.d.	120	6.56	12.47	5.854	0.1625	0.605	0.235	-14.9
RF45	03.03.2014	82	0.15	n.d.	137	6.62	12.18	2.755	0.0485	8.65	0.667	-18.7
RF27	25.02.2014	106.16	0.91	n.d.	68	n.d.	6.79	5.523	0.2241	0.700	0.568	-13.3
RF44	27.02.2014	115.39	0.15	n.d.	240	6.61	18.5	34.51	1.8222	0.628	0.178	-11.3
RF65	05.03.2014	116.88	0.12	n.d.	579	7.08	77.4	14.27	0.2261	0.348	0.057	-11.2
RF38	27.02.2014	175.29	0.78	n.d.	78	6.33	8.03	2.022	0.0761	1.955	0.888	-19.6
RF7	19.02.2014	177.45	0.14	n.d.	665	7.43	83.3	5.25	0.094	0.897	0.427	-14.7
RF62	04.03.2014	190	0.17	n.d.	409	6.86	51.5	9.796	0.2684	0.169	0.0747	-13.9
RF60	04.03.2014	220	0.19	n.d.	258	6.62	34.3	36.25	0.1377	0.158	0.1398	-18
RF61	04.03.2014	253	0.22	n.d.	415	6.86	52.7	10.52	0.266	0.174	0.2331	-10.4
RF8	19.02.2014	275.16	0.16	n.d.	576	7.42	75.05	4.536	0.0763	0.322	0.2176	-14.8
RF40	27.02.2014	280.59	0.16	n.d.	47	6.31	4.66	2.496	0.1074	1.513	0.467	-19.9
RF5	19.02.2014	302.46	0.18	n.d.	621	7.38	79.8	6.377	0.1199	0.516	0.095	-14.3
RF4	19.02.2014	320.04	0.28	n.d.	688	7.45	85.4	4.869	0.0844	1.59	0.739	-13.9
RF37	27.02.2014	350	0.88	n.d.	57	6.48	6.18	1.585	0.0714	1.305	0.680	-18.7
RF47	03.03.2014	598	1.60	n.d.	125	6.15	6.362	14.27	0.6597	16.55	0.483	-12.8
RF12	19.02.2014	689	1.27	n.d.	489	7.17	63.66	12.28	0.2796	0.3438	0.133	-10.2
RF58	04.03.2014	732	1.62	n.d.	258	6.65	30.98	6.234	0.2358	0.267	0.383	-15.6
RF42	27.02.2014	820.66	2.38	n.d.	95	6.41	7.58	2.735	0.0761	6.85	0.469	-18.5
RF6	19.02.2014	1020.47	0.63	n.d.	568	7.29	74.4	7.105	0.1442	0.570	0.186	-14.9
RF53	03.03.2014	1260	1.80	n.d.	237	6.50	16.2	11	0.3805	24.0	0.810	-9.6
RF51	03.03.2014	1648	4.12	n.d.	100	6.24	8.08	15.76	0.2495	8.68	0.525	-12.3
RF57	03.03.2014	3190	n.d.	n.d.	608	6.70	44.22	48.61	0.2349	76.4	0.335	-10.5
RF11	19.02.2014	3460	9.35	n.d.	403	7.06	50.84	10.29	0.3459	0.353	0.163	-12.6
RF28	25.02.2014	4030	11.8	n.d.	95	6.26	8.193	3.954	0.2199	1.455	2.82	-17.2
RF32	26.02.2014	5110	17.1	n.d.	63	6.34	6.143	2.819	0.0552	0.964	0.38	-18.2
RF21	25.02.2014	5190	13.8	n.d.	120	6.34	7.79	11.61	0.3771	4.61	4.34	n.d.
RF43	27.02.2014	9881	33.3	n.d.	132	6.38	9.97	4.347	0.0892	8.36	0.733	-16.3
RF50	03.03.2014	10768	31.9	n.d.	88	6.29	10.02	16.4	0.3752	2.02	0.551	-14
RF3	19.02.2014	12000	n.d.	n.d.	707	7.32	13.78	36.67	0.1549	11.01	5.79	-13.6
RF64	05.03.2014	25500	28.6	n.d.	460	6.92	58.4	8.906	0.1807	1.96	0.843	-16.6
RF9	19.02.2014	27200	21.2	n.d.	558	7.14	68.8	13.44	0.3596	8.78	1.63	-14.4
RF56	03.03.2014	27622	95.3	n.d.	131	6.55	10.9	15.02	0.1124	11.0	0.470	-14.3
RF63	04.03.2014	63780	81.6	n.d.	358	6.96	44.1	52.46	0.3612	4.52	0.735	-12.6
RF1	19.02.2014	423100	n.d.	n.d.	317	7.58	25.7	8.359	0.0538	3.69	13.17	-10.3

Table S2. Results of the non-parametric H-criterium Kraskal-Wallist test. Only Statistically significant values are shown.

S2-A. Comparison of three permafrost zone (all rivers, all seasons)

Component	H (Kryckal-Wallis)	p - level
Specific conductivity	62.654	< 0.0001
pH	91.259	< 0.001
DIC	93.955	< 0.001
DOC	26.559	< 0.0001
Cl	23.982	< 0.0001
Na	27.856	< 0.0001
Mg	91.893	< 0.001
Si	9.5102	0.0086
K	86.669	< 0.001
Ca	116.34	< 0.001

S2-B. Comparison of different seasons (all rivers)

Component	H (Kryckal-Wallis)	p - level
Specific conductivity	45.197	< 0.0001
pH	48.907	< 0.0001
DIC	69.67	< 0.0001
DOC	10.58	0.0142
Cl	29.94	< 0.0001
Na	27.82	< 0.0001
Mg	64.762	< 0.0001
Si	94.877	< 0.001
K	52.302	< 0.0001
Ca	34.145	< 0.0001

S2-C. Comparison of 4 watershed classes (< 100 km^2, 100 to 1000 km^2, 1000 to 10,000 km^2 and > 10,000 km^2) in spring

Component	H (Kryckal-Wallis)	p - level
Specific conductivity	7.977	0.0465
pH	8.092	0.0441
DIC	8.140	0.0432
SO4	20.42	0.0001
Si	9.165	0.0272
K	12.57	0.0056

S2-D. Comparison of 4 watershed classes (< 100 km^2, 100 to 1000 km^2, 1000 to 10,000 km^2 and > 10,000 km^2) during all seasons.

Component	H (Kryckal-Wallis)	p - level
Specific conductivity	21.282	0.0001
pH	18.908	0.0003
DIC	18.313	0.0004
SO4	25.593	< 0.0001
Na	20.863	0.0001
Mg	20.269	0.0001
K	35.215	< 0.0001
Ca	21.680	0.0001

S2-E. Comparison of 4 watershed classes (< 100 km², 100 to 1000 km², 1000 to 10,000 km² and > 10,000 km²) in winter.

Component	H (Kryckal-Wallis)	p - level
Specific conductivity	11.968	0.0075
pH	11.291	0.0102
DIC	10.349	0.0158
DOC	7.865	0.0489
Cl	7.833	0.0496
SO4	9.033	0.0288
Na	11.37	0.0099
Mg	13.93	0.0030
K	9.795	0.0204
Ca	12.49	0.0059

S2-F. Comparison of 6 latitudinal classes (56-58º, 58-60º, 60-62º, 62-64º, 64-66º, 66-68º) in spring.

Component	H (Kryckal-Wallis)	p - level
Specific conductivity	45.06	< 0.0001
pH	45.05	< 0.0001
DIC	45.50	< 0.0001
DOC	41.60	< 0.0001
Cl	29.65	< 0.0001
Na	29.43	< 0.0001
Mg	51.011	< 0.0001
Si	11.937	0.0357
K	41.129	< 0.0001
Ca	53.051	< 0.0001

S2-G. Comparison of 6 latitudinal classes (56-58º, 58-60º, 60-62º, 62-64º, 64-66º, 66-68º) in winter

Component	H (Kryckal-Wallis)	p - level
Specific conductivity	39.044	< 0.0001
pH	33.483	< 0.0001
DIC	40.452	< 0.0001
DOC, ppm	14.627	0.0055
Cl, ppm	12.766	0.0125
Na	31.139	< 0.0001
Mg	35.491	< 0.0001
Si	16.060	0.0029
K	26.948	< 0.0001
Ca	40.461	< 0.0001