Supplementary Material
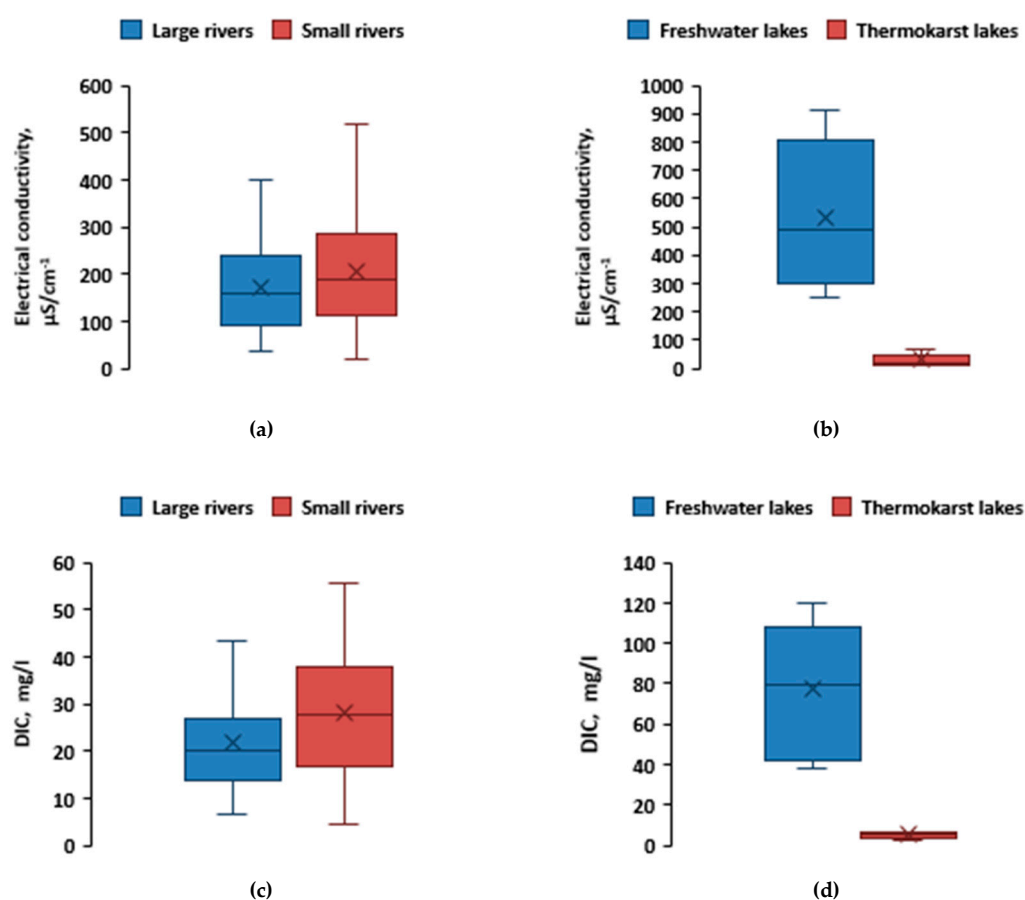

(a)

(b)

(c)

(d)

Figure S1. Box plot of median and IQR range (with outlies as dots) of electrical conductivity in rivers **(a)**; lakes **(b)**; DIC concentrations in rivers **(c)**; and lakes **(d)**, averaged across seasons.
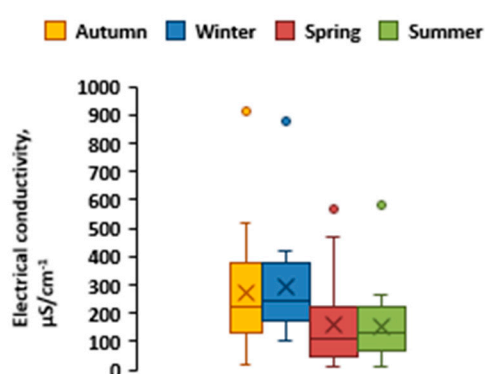

Figure S2. Boxplots (median and IQR range) of electrical conductivity during different seasons (lakes and rivers combined together)
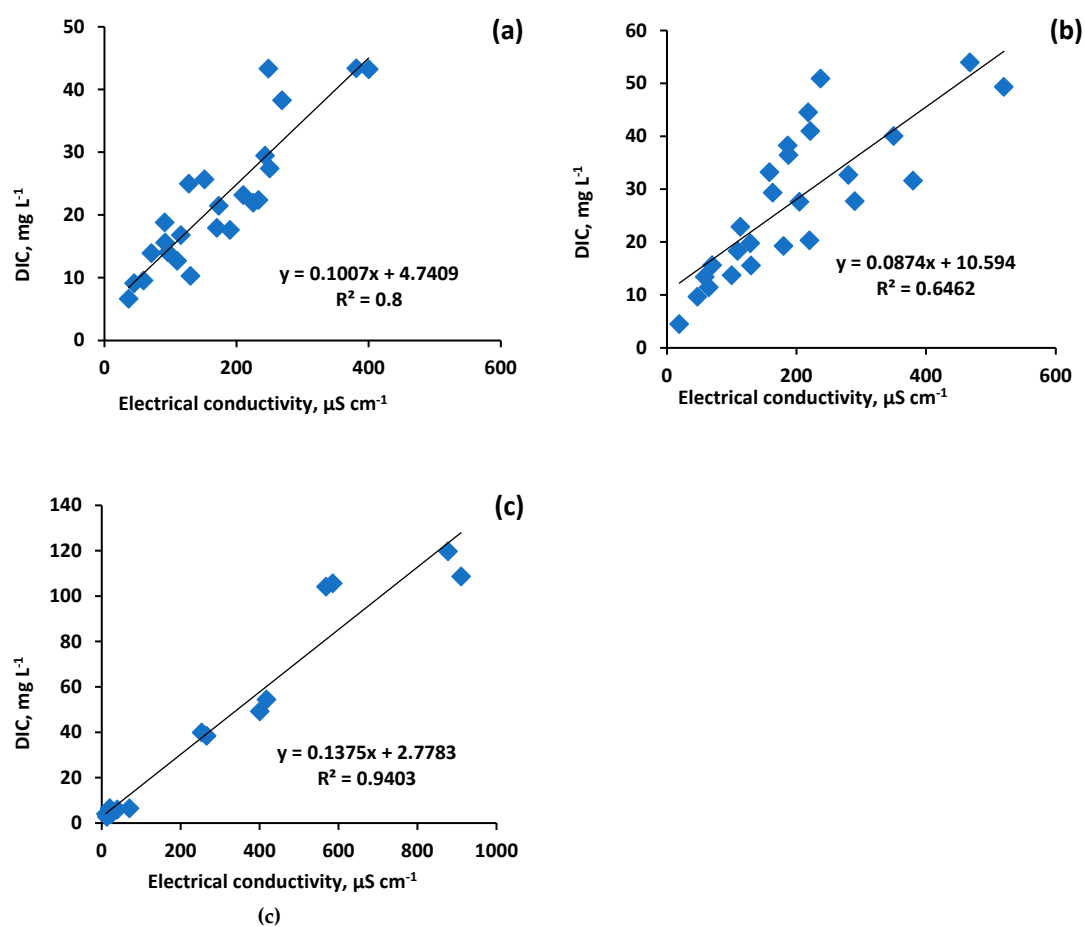
Figure S3. Plots of DIC concentration (mg L^{-1}) as a function of electrical conductivity in large rivers (a), small rivers **(b)** and lakes **(c)**.

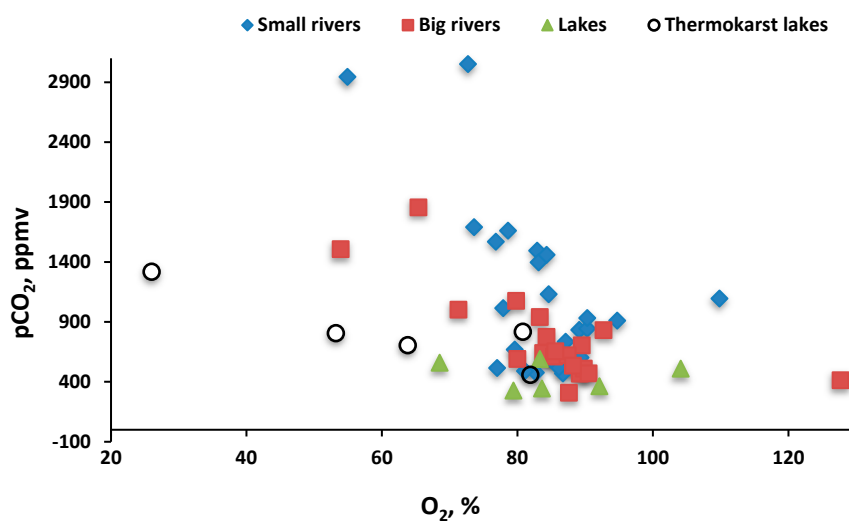**Figure S4.** The relationship between pCO$_2$ and oxygen saturation degree of lake and river waters in the Tyva region (all seasons together).
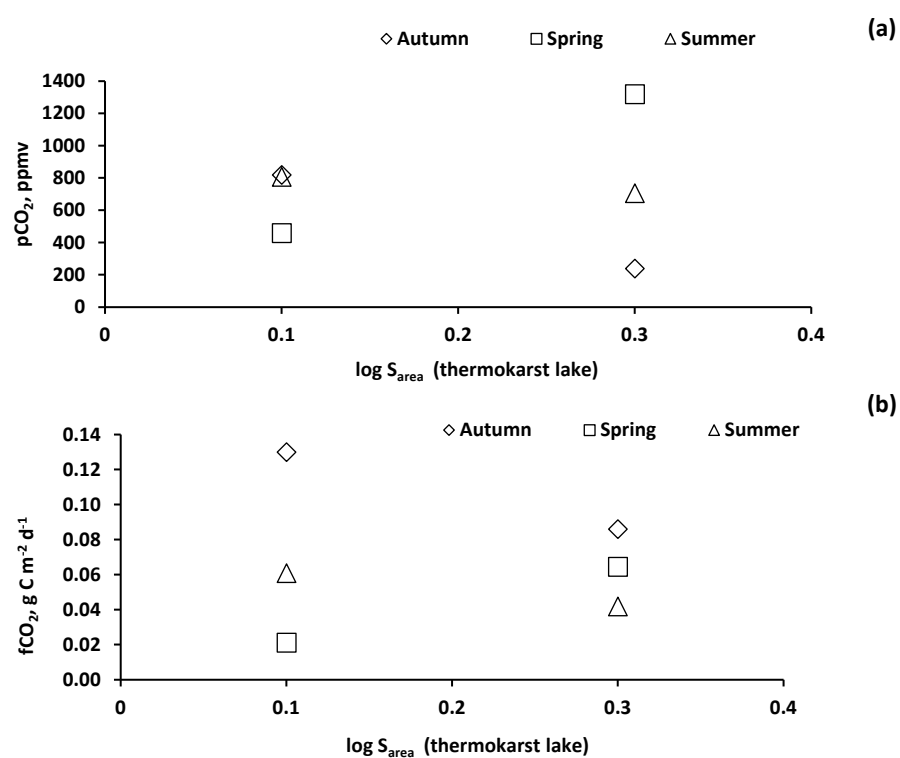
Figure S5. The relationship between **(a)** pCO_2 and **(b)** fCO_2 and thermokarst lakes water surface area of the Tyva region.
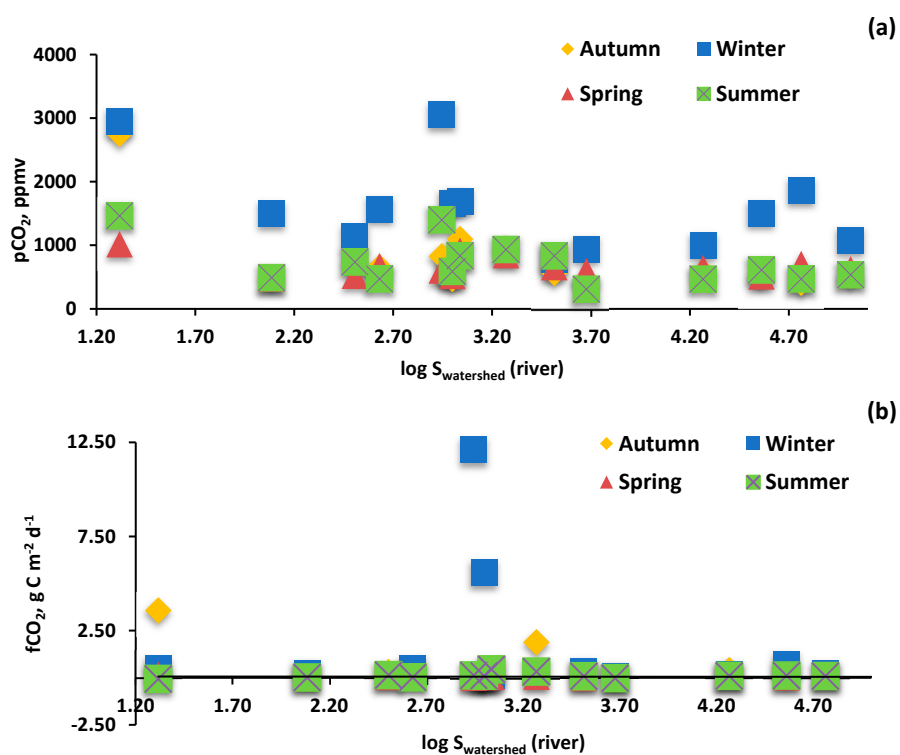

Figure S6. The relationship between pCO_2 **(a)** and fCO_2 **(b)** in river watershed area in the Tyva region (all seasons together).

Table S1. Pearson correlation coefficients between major hydrochemical and microbiological parameters of the water column, including pH, O2, S.C., DOC, DIC and optical parameters of DOM reflecting DOM quality. S_{area}, S.C., and TBC represent area of the lake surface or river watershed, Electrical Conductivity, and Total Bacterial Count, respectively.

Large rivers

	E.C.	T_{water}	pH	O_2	pCO_2	TBC	DIC	DOC	$SUVA_{254}$	E2:E3	$E_{254}:E_{436}$	S_R	fCO_2
S_{area}	0.05	0.28	0.04	-0.11	0.18	0.27	0.12	0.80	0.14	-0.23	0.55	-0.47	0.08
E.C.		-0.31	0.80	0.54	-0.05	-0.17	0.96	-0.29	-0.88	0.53	-0.64	0.35	0.85
T_{water}			-0.50	-0.83	0.64	0.84	-0.09	0.49	0.29	-0.81	0.57	-0.52	-0.39
pH				0.66	-0.41	-0.22	0.73	-0.42	-0.74	0.78	-0.69	0.52	0.64
O_2					-0.47	-0.77	0.31	-0.44	-0.48	0.78	-0.60	0.78	0.61
pCO_2						0.29	0.06	0.15	-0.02	-0.69	0.22	-0.37	-0.01
TBC							0.10	0.41	0.09	-0.60	0.38	-0.57	-0.41
DIC								-0.20	-0.87	0.37	-0.55	0.15	0.72
DOC									0.54	-0.52	0.90	-0.64	-0.16
$SUVA_{254}$										-0.43	0.82	-0.35	-0.55
E2:E3											-0.67	0.66	0.54
$E_{254}:E_{436}$												-0.60	-0.39
S_R													0.44

Small rivers

	E.C.	T_{water}	pH	O_2	pCO_2	TBC	DIC	DOC	$SUVA_{254}$	E2:E3	$E_{254}:E_{436}$	S_R	fCO_2
S_{area}	0.54	0.38	0.52	-0.01	-0.53	-0.43	0.63	-0.20	-0.52	-0.03	-0.30	-0.01	-0.58
E.C.		0.01	0.77	0.54	-0.05	-0.01	0.81	-0.16	-0.68	0.31	-0.46	0.33	-0.16
T_{water}			-0.24	-0.66	-0.28	-0.54	0.27	-0.14	0.03	-0.71	0.04	-0.49	-0.45
pH				0.67	-0.32	-0.13	0.57	-0.04	-0.83	0.46	-0.44	0.35	-0.22
O_2					-0.02	0.30	0.02	-0.01	-0.49	0.71	-0.32	0.50	0.04
pCO_2						0.21	-0.11	-0.38	0.27	0.32	-0.27	0.49	0.94
TBC							-0.10	0.30	0.31	0.23	0.23	-0.07	0.17
DIC								-0.06	-0.50	-0.04	-0.28	0.00	-0.22
DOC									0.42	-0.16	0.89	-0.59	-0.28
$SUVA_{254}$										-0.32	0.71	-0.54	0.24
E2:E3											-0.38	0.73	0.40
$E_{254}:E_{436}$												-0.68	-0.22
S_R													0.51

Freshwater lakes

	E.C.	T_{water}	pH	O_2	pCO_2	TBC	DIC	DOC	$SUVA_{254}$	E2:E3	$E_{254}:E_{436}$	S_R	fCO_2
S_{area}	0.84	0.40	0.69	-0.34	-0.64	0.44	0.99	0.92	-0.85	0.79	-0.69	0.58	-0.88
E.C.		-0.14	0.89	0.08	-0.81	-0.02	0.89	0.93	-0.62	0.97	-0.19	0.91	-0.85
T_{water}			-0.31	-0.86	0.29	0.73	0.31	0.16	-0.61	-0.23	-0.94	-0.42	-0.26
pH				0.44	-0.99	0.13	0.77	0.68	-0.27	0.97	-0.03	0.74	-0.53
O_2					-0.50	-0.29	-0.23	-0.29	0.74	0.27	0.78	0.17	0.45
pCO_2						-0.23	-0.72	-0.57	0.17	-0.92	0.02	-0.62	0.41
TBC							0.41	0.04	-0.26	0.05	-0.77	-0.44	-0.02
DIC								0.91	-0.79	0.85	-0.61	0.63	-0.86
DOC									-0.86	0.83	-0.45	0.83	-0.98
$SUVA_{254}$										-0.46	0.78	-0.46	0.92
E2:E3											-0.11	0.85	-0.71

	E.C.	T_water	pH	O₂	pCO₂	TBC	DIC	DOC	SUVA₂₅₄	E2:E3	E₂₅₄:E₄₃₆	SR	fCO₂
E₂₅₄:E₄₃₆												0.14	0.51
S_R													-0.76

				Thermokarst lakes									
	E.C.	**T_water**	**pH**	**O₂**	**pCO₂**	**TBC**	**DIC**	**DOC**	**SUVA₂₅₄**	**E2:E3**	**E₂₅₄:E₄₃₆**	**SR**	**fCO₂**
S_area	0.86	0.25	0.31	-0.07	0.17	-0.31	0.47	0.88	0.26	0.57	0.74	-0.30	0.00
E.C.		-0.22	0.71	0.41	-0.25	0.15	0.62	0.96	-0.05	0.90	0.51	0.13	0.24
T_water			-0.84	-0.72	0.52	-0.99	-0.56	-0.23	0.24	-0.61	0.16	-0.98	-0.77
pH				0.69	-0.44	0.80	0.80	0.71	-0.12	0.93	0.23	0.79	0.74
O₂					-0.95	0.65	0.11	0.23	-0.80	0.70	-0.49	0.57	0.16
pCO₂						-0.45	0.19	-0.02	0.94	-0.50	0.69	-0.35	0.12
TBC							0.57	0.17	-0.17	0.54	-0.15	0.99	0.81
DIC								0.78	0.50	0.69	0.72	0.62	0.88
DOC									0.21	0.85	0.71	0.19	0.41
SUVA₂₅₄										-0.23	0.83	-0.07	0.43
E2:E3											0.28	0.52	0.47
E₂₅₄:E₄₃₆												-0.07	0.42
SR													0.86