Supplementary information - Hydrological connectivity controls dissolved organic carbon exports in a peatland-dominated boreal catchment stream

Antonin Prijac[1,2,3], Laure Gandois[4], Pierre Taillardat[1,2,5], Marc-André Bourgault[6], Khawla Riahi[7], Alex Ponçot[1], Alain Tremblay[8], Michelle Garneau[1,2,3]

[1] Centre de Recherche sur la Dynamique du Système Terre (GÉOTOP), Université du Québec à Montréal, Canada
[2] Groupe de Recherche Inter-universitaire en Limnologie (GRIL), Université du Québec à Montréal, Canada
[3] Institut des Sciences de l'Environnement (ISE), Université du Québec à Montréal, Canada
[4] Laboratoire Écologie Fonctionnelle et Environnement, UMR 5245, CNRS-UPS-INPT, Toulouse, France
[5] NUS Environmental Research Institute, National University of Singapore, Singapore
[6] Département de Géographie, Université Laval, Québec, Canada
[7] Centre Eau, Terre et Environnement, Institut National de la Recherche Scientifique, Québec, Canada
[8] Programme Gaz à Effet de Serre, Hydro Québec, Montréal, Québec, Canada

Correspondence to: Antonin Prijac (antonin.prijac@gmail.com) and Laure Gandois (laure.gandois@cnrs.fr)

Table SI.1. Models of fDOM captor calibration for DOC concentrations

| Model reference	Sonde	Covered period	Model	n	R^2	p-value
Calibration Model I	EXO2-A	June 2018-August 2018	[DOC] = 0.2489 * fDOMcor - 1.2088	20	0.94	< 0.0001
Calibration Model II.1	EXO2-B	August 2018-July 2019	[DOC] = 0.4074 *fDOMcor – 0.8373	29	0.82	< 0.0001
Calibration Model II.2	EXO2-A	July 2019-August 2019	[DOC] = 4.3114 * fDOMcor + 0.9833	10	0.98	< 0.0001
Calibration Model II.3	EXO2-B	August 2019-May 2020	[DOC] = 8.3384 * fDOMcor + 3.1014	10	0.80	< 0.0001
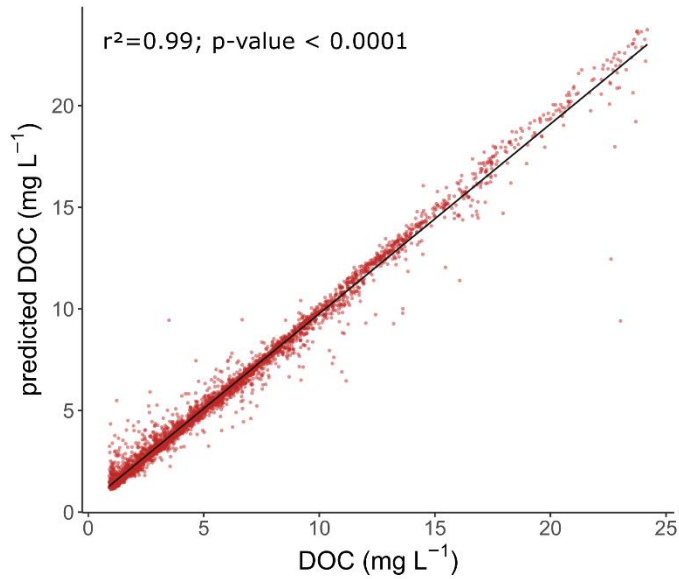
Figure SI.1. Relation between observed DOC concentrations and DOC predicted by random forest model on the training dataset

Table SI.2. Importance of variables in the random forest model of DOC concentrations (%MeanDecreaseAccuracy) and correlation between DOC concentrations and hydrological and physicochemical variables for the data set from the growing season.

DOC ~	Variable importance (%MeanDecreaseAccuracy)	Correlations					
		Complete Time Serie		Growing season		High flow Events	
		Rho	p-value	Rho	p-value	Rho	p-value
WTD	24.47	0.43	<0.0001	0.43	<0.0001	0.22	<0.0001
Porewater T°	16.52	n.a.	n.a.	-0.06	0.0007	-0.23	<0.0001
Q	16.33	0.41	<0.0001	0.39	<0.0001	0.42	<0.0001
SPC	12.04	-0.12	<0.0001	-0.26	<0.0001	-0.23	<0.0001
pH	7.97	-0.05	<0.0001	-0.10	<0.0001	-0.19	<0.0001
DO (%sat)	5.94	0.19	<0.0001	-0.06	0.0003	0.00	0.9271
Water T°	3.25	0.30	<0.0001	-0.05	0.0039	0.09	0.0013
Air T°	2.75	n.a.	n.a.	-0.01	0.7322	0.12	<0.0001
DO (mg L^{-1})	NA	-0.02	0.085	-0.02	0.3245	-0.05	0.06

Table SI.3. Summary of variables for each flood events. Variables includes the duration of events, the initial, maximal and delta (Δ) for the stream discharge, the WTD and the DOC concentration. The hysteretic index (HI), flushing index (FI) and β are indices which characterize the storm events. Precipitation variables are composed by total precipitation during events (PP event), antecedent precipitation 48h (AP48) and 14 days (AP14) prior to the beginning of an event and Total PP correspond to the sum of AP14 and PP event. The PQ lag time correspond to the duration between a precipitation event and the beginning of the increase of the discharge. The Q lag time correspond to the duration between the beginning of the discharge increase and the discharge peak. The DOC lag time correspond to the duration between the discharge peak and the DOC peak. DOC90 correspond to the period when 90% of the maximum DOC concentration was exceeded.

Event name	Aa	Ab	Ac	Ad	Ae	Af	Ba	Bb	Bc	Bd	Be	Bf
Cluster	CLUSTER 3	CLUSTER 1	CLUSTER 1	CLUSTER 1	CLUSTER 1	CLUSTER 1	CLUSTER 2	CLUSTER 3	CLUSTER 1	CLUSTER 1	CLUSTER 2	CLUSTER 2
Event Begining	2018-06-17	2018-07-05	2018-08-22	2018-09-17	2018-09-21	2018-09-26	2019-06-16	2019-08-09	2019-08-29	2019-09-04	2019-09-07	2019-09-26
Event End	2018-06-28	2018-07-09	2018-08-24	2018-09-21	2018-09-25	2018-10-02	2019-06-21	2019-08-13	2019-09-02	2019-09-07	2019-09-11	2019-10-03
Duration (day)	10	4	2	4.4	3.7	6.4	5.2	4.5	3.7	3.3	3.7	6.6
Stream T°C min (°C)	5.9	9.3	12.4	5.5	2.5	2.4	7.1	9.9	7.5	6.7	7.4	2.4
Stream T°C max (°C)	19.5	20.4	16.9	12.6	12.3	12.9	19.5	19.6	19.0	15.0	13.9	12.2
Stream T°C average (°C)	11.3	14.4	14.9	8.6	7.8	7.8	10.9	14.4	13.5	11.0	9.8	7.8
Porewater T°C min (°C)	6.3	10.1	13.7	10.8	9.6	9.1	7.5	14.3	13.7	12.0	10.8	9.0
Porewater T°C max (°C)	8.0	10.6	13.8	12.3	10.8	9.7	8.3	14.9	14.6	13.2	12.2	10.3
Porewater T°C average (°C)	7.3	10.5	13.8	11.3	10.3	9.4	7.7	14.7	14.4	12.7	11.3	9.7
Q initial (m³ h⁻¹)	102.1	79.4	24.8	68.9	63.4	76.5	73.8	30.6	24.8	51.2	100.9	48.3
Q max (m³ h⁻¹)	245.7	172.8	92.8	119.6	178.4	129.3	323.0	333.8	167.7	216.1	360.8	240.6
ΔQ (m³ h⁻¹)	143.7	93.5	68.1	50.8	115.1	52.8	249.3	303.3	142.9	164.9	260.0	192.3
WTD initial (m)	-0.25	-0.28	-0.34	-0.33	-0.26	-0.23	-0.17	-0.36	-0.39	-0.25	-0.23	-0.23
WTD max (m)	-0.11	-0.15	-0.17	-0.17	-0.13	-0.14	-0.09	-0.11	-0.14	-0.15	-0.13	-0.14
ΔWTD (m)	0.14	0.13	0.17	0.06	0.13	0.09	0.08	0.25	0.24	0.10	0.10	0.09
DOC initial (mg L⁻¹)	7.0	3.2	3.5	1.1	3.0	6.7	4.1	0.3	2.4	4.6	8.1	4.5
DOC max (mg L⁻¹)	14.6	9.2	5.5	4.8	11.5	10.8	8.0	22.7	13.5	16.5	20.2	10.3
ΔDOC (mg L⁻¹)	7.5	6.0	2.0	3.7	8.5	4.1	3.9	22.5	11.1	11.9	12.1	5.8
HI	-0.37	-0.54	-0.17	-0.47	-0.56	-0.44	0.05	-0.31	-0.44	-0.47	-0.20	-0.16
β	0.66	0.88	0.21	0.46	0.46	0.60	0.30	0.97	0.70	0.64	0.41	0.82

FI	0.62	0.41	0.53	0.29	0.25	0.02	0.64	0.98	0.59	0.80	0.67	0.64
PP event (mm)	NA	NA	18	6	21	13	19	34	33	8	13	17
AP48 (mm)	NA	NA	4	16	1	1	12	20	12	15	6	18
AP14 (mm)	NA	NA	10	41	30	43	29	42	25	66	71	26
Total PP(mm)	NA	NA	28	47	51	57	49	76	58	74	84	42
PQ lagtime (hour)	NA	NA	3	4	3	3	2	5	7	7	3	5
Q lagtime (hour)	31	19	15	27	17	22	23	26	39	27	27	28
DOC lagtime (hour)	14	32	7	36	32	35	11	8	11	16	8	13
DOC_{90} (hour)	12	9	2	9	17	13	12	11	12	6	4	5
DOC load (kg)	433.02	73.35	15.34	25.71	89.33	103.14	108.75	307.09	106.17	84.83	274.21	101.26
DOC load (kg h^{-1})	1.75	0.82	0.32	0.24	1.02	0.68	0.84	2.50	1.19	1.10	3.26	0.64

Table SI.4. Results of v.test represent the contribution of variables to each three clusters and the comparison of average in the cluster and the overall average of the variable. Only variables which significantly influenced at least one cluster were represented.

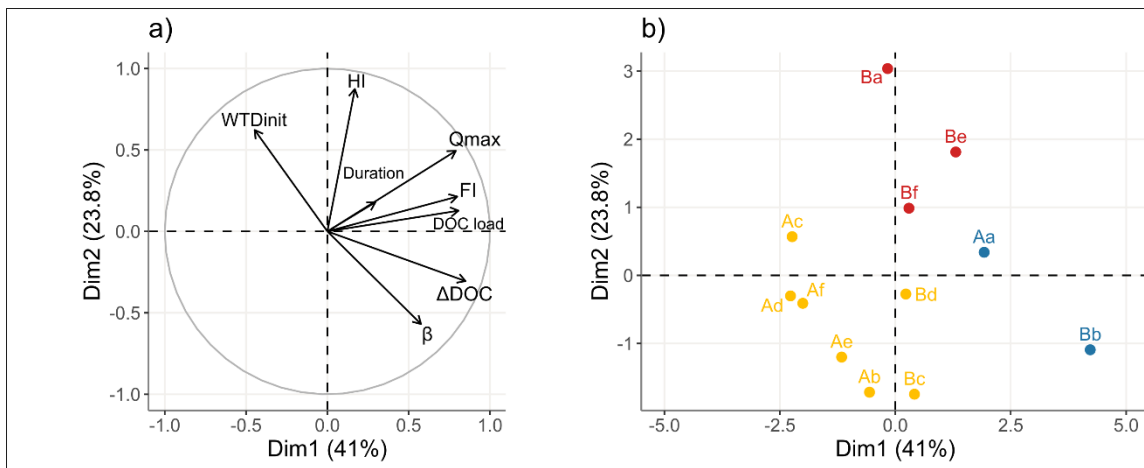| CLUSTER	Variable	v.test	Mean in category	Overall mean	p-value
	HI	-2.26	-0.44	-0.34	0.0241
#1	DOC load	-2.35	71.13	143.52	0.0187
	Q_{max}	-2.85	153.81	215.05	0.0043
#2	HI	2.56	-0.10	-0.34	0.0106
	Q_{max}	2.11	308.13	215.05	0.0346
#3	DOC load	2.78	370.06	143.52	0.0054

Figure SI.2 Representation of the two first axis of principal component analyses (PCA) of a) variables used for the clustering and b) storm events as individuals. Variables considered in the events clustering are the DOC load, the DOC lag time, the DOC increase and the minimum DOC concentrations, the Q lag time, the maximum and the minimum WTD and the HI index. The two first dimensions explained 63.8% of the total variance. The major contributors of the first axis were the ΔDOC (22%), the DOC load (19.8%), the flushing index (FI; 19.4%), the Qmax (19%) and the β index (10.1%). The major contributors of the second axis were the HI (40.1%), the WTD init (20.3%), the β index (17%) and the Qmax (12.8%). Other variables contribute less than 10% to the first two axis.
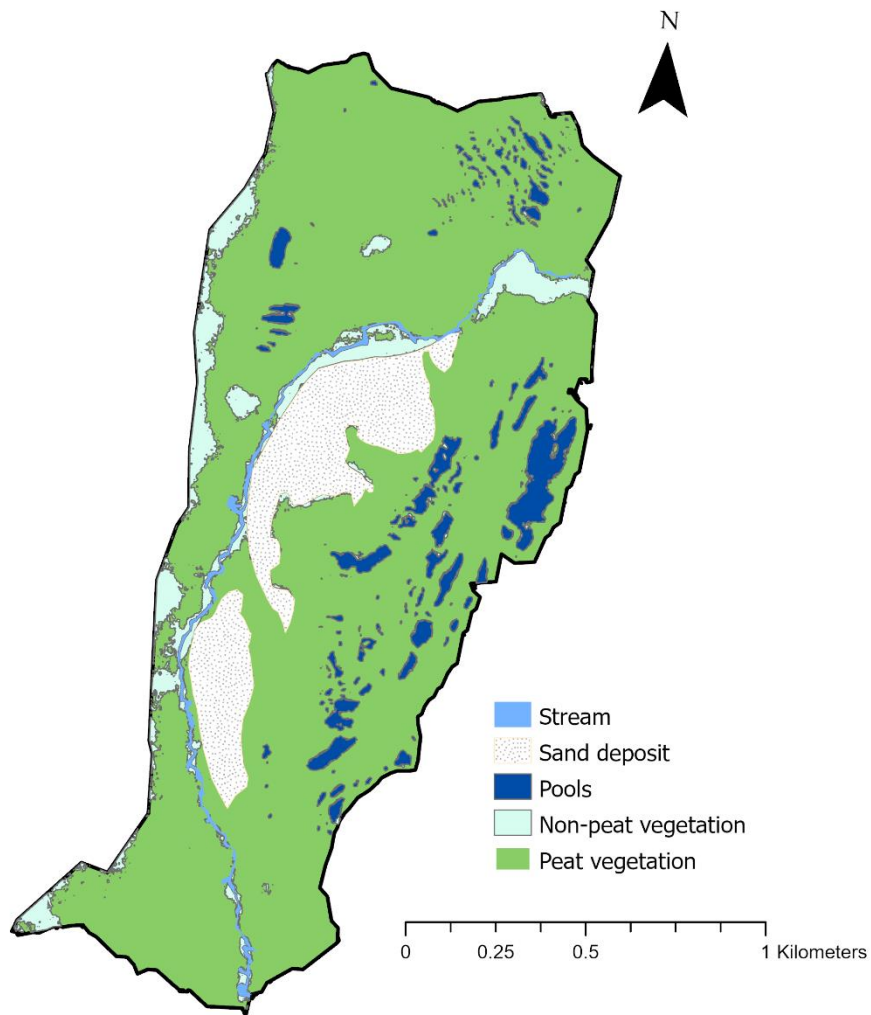
Figure SI.2 Map of the land cover in the Bouleau peatland watershed which distinguishing the areas covered by peat, pools, stream and non-peat vegetation and the sand deposits.