

AGU Publication

Geophysical Research: Biogeosciences

Supporting Information for

Tale of Two Storms: Impact of Extreme Rain Events on the Biogeochemistry of Lake Superior

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Table S-1. 2012 sample site locations.

2012

Table 1 Sampling Site locations

Site Name	Site Initials	Water Column Depth (m)	Latitude, Longitude
Duluth Entry	DE	22	46°47'0.00"N 92° 3'60.00"W
Wisconsin Entry	WE	0	46°43'14.92"N 92° 0'34.08"W
Off Shore	OS	30	46°47'14.92"N 91°57'34.08"W
Middle Western Arm	M1	132	46°55'14.93"N, 91°27'34.08"W

Table S-2. CTD data

<i>CDOM (mg/m³)</i>	<i>6/21</i>	<i>6/25</i>	<i>6/29</i>	<i>7/5</i>	<i>7/14</i>	<i>7/20</i>	<i>8/2</i>	<i>8/10</i>	<i>8/17</i>	<i>8/22</i>	<i>8/31</i>	<i>9/7</i>	<i>9/21</i>
<i>Sites Sampled</i>													
M1						17.54	3.84	4.37		1.51	0.33	1.00	1.59
OS	28.00	76.47	35.46	61.44	34.90	14.13	3.72	4.84	7.14	3.24	5.02	3.65	3.02
WE	107.54	110.95	275.76	135.72	102.41	38.90	10.37	2.82	5.04	13.69	5.78	7.95	
DE	105.97	226.39	114.27	19.68	78.66	46.17	4.42	4.29	6.52	10.07	4.27	8.85	2.64
<i>Xmiss (%)</i>	<i>6/21</i>	<i>6/25</i>	<i>6/29</i>	<i>7/5</i>	<i>7/14</i>	<i>7/20</i>	<i>8/2</i>	<i>8/10</i>	<i>8/17</i>	<i>8/22</i>	<i>8/31</i>	<i>9/7</i>	<i>9/21</i>
<i>Sites Sampled</i>													
M1						83.48	91.14	88.26		91.48	91.36	94.18	91.60
OS	82.47	1.84	39.90	36.99	46.72	86.12	90.88	87.78	86.01	88.22	90.35	93.50	92.60
WE	4.97	0.97	5.36	25.46	38.11	68.63	81.09	82.49	85.91	79.00	88.86	83.00	
DE	-0.07	0.83	11.66	55.41	34.72	69.61	90.61	87.85	83.05	83.29	90.66	88.76	92.29

<i>Chla Wet Star (mg/m³)</i>	6/21	7/5	7/14	7/20	8/2	8/10	8/17	8/22	8/31	9/7	9/21	9/27	
<i>Sites Sampled</i>													
M1				1.48	0.70	0.68		1.01	1.26	0.54	0.45		
OS	1.43	2.18	1.18	1.00	0.81	0.87	0.97	0.95	1.56	0.88	0.92		
WE	2.74	3.50	2.07	1.96	1.51	0.71	1.30	1.49	1.88	1.60		2.06	
DE	2.74	1.63	1.47	1.65	1.08	1.17	1.53	1.46	1.31	1.48	1.25	0.43	

Note: **Bold** indicated values for non-plume, Column headings are month/day, derived from: Minor, E. C., Forsman, B., & Guildford, S. J. (2014), The effect of a flood pulse on the water column of western Lake Superior, USA. Journal of Great Lakes Research, 40(2), 455-462.

Table S-3. 2012 Satellite Data

<i>Kd (1/m)</i>	6/25	6/29	7/5	7/14	7/20	8/5	8/10	8/17	8/22	8/31	9/7	9/21
<i>Sites Sampled</i>												
M1	0.37	0.37	0.49	0.43	0.24	0.47	0.42	1.13	0.13	0.29	0.15	0.15
OS			0.24	3.35	0.79	0.54	0.66	0.85	3.00	2.24	1.33	0.21
WE			0.94	1.60	1.34	1.02	1.08	3.30	0.89		0.88	0.39
DE				0.78	2.10	1.70	1.04	0.66	1.73		1.28	0.46

Note: **Bold** indicated values for non-plume, Column headings are month/day

Table S-4. 2012 Water Quality Data.

<i>Chla discreet measuments ug/L</i>								
<i>Sites Sampled</i>	6/25	6/29	7/5	7/14	7/20	8/17	8/22	9/27
M1					1.925			
OS	0.719		1	0.4	0.685	1.18	0.66	
WE	0.56	0.50	1.6	0.30	1.786	1.37	1.92	1.7
DE	0.42		1.3	0.1	1.530	1.46	0.36	
TP (ug/L)	6/21	6/25	6/29 (6/30)	7/14	7/20	8/2	8/10	8/17

Sites Sampled	n (3)	n (2)	n (2)	n (2)	n (2)	n (2)	n (2)	n (2)
M1					4.42+/-0.04	3.04+/-0.04	5.7+/-0.3	
OS	7.0+/-0.2	40.5+/-0.3	15.62+/-0.04	11.8+/-0.5	2.8+/-0.1	3.0+/-0.3	2.3+/-0.1	3.7+/-0.2
WE	103.6+/-11.9	52.4+/-0.9	56.65+/-0.30	18.7+/-1.6	9.89+/-0.02	7.4+/-0.5	10.8+/-1.4	5.0+/-0.6
DE	144.0+/-3.8	40.8+/-0.1	29.80+/-0.40	12.4+/-1.9	10.27+/-0.01	3.82+/-0.06	10.6+/-1.2	7.6+/-1.4
SRP (ug/L)	6/21	7/14	7/20	8/2	8/10	8/17		
Sites Sampled	n (2)	n (2)	n (2)	n (2)	n (2)	n (2)		
M1			1.12	0.88	0.85			
OS	0.93+/- .011	1.3+/-0.3	0.98	1.3+/-0.2	0.67+/-0.01	0.86+/-0.06		
WE	5.80+/-0.06	1.95+/-0.08	1.17	1.14+/-0.03	0.857+/-0.008	0.73+/-0.06		
DE	4.7+/-0.1	2.41+/-0.05	1.69	1.07+/-0.09	0.76+/-0.03	1.68+/-0.02		
NO ₂ /NO ₃ (mg/L)	6/21	6/25	6/29	7/14	7/20	8/8	8/10	8/17
Sites Sampled	n (3)			n (2)	n (2)	n (2)	n (2)	n (2)
M1					0.38	0.35	0.37	
OS	0.365+/-0.001	0.33	0.35	0.36	0.37	0.36	0.37	0.36
WE	0.308+/-0.000	0.30	0.13	0.348+/-0.000	0.350+/-0.001	0.363+/-0.000	0.355+/-0.000	0.358+/-0.000
DE	0.310+/-0.001	0.33	0.29	0.38+/-0.02	0.35+/-0.02	0.364+/-0.006	0.361+/-0.001	0.364+/-0.003
TN (mg/L)	6/21	6/25	6/29	7/14	7/20	8/2	8/10	8/17
Sites Sampled	n (2)	n (2)						
M1					0.47	0.55		
OS	1.28+/-0.01	0.586+/-0.001	0.56	0.50	0.47	0.46	0.46	0.46
WE	1.451+/-0.005	0.610+/-0.002	0.97	0.63	0.50	0.48	0.45	0.47
DE	1.41+/-0.01	0.592+/-0.008	0.65	0.50	0.55	0.47	0.45	0.47

Note: Column headings are month/day. This data was included in figures from Minor et al 2014. **Bold** indicates values for non-plume, italicized values are +/- are standard deviations, non italicized +/- are average deviations, number of measurements n ().

Table S-5. 2016 sample site locations and date of CTD profiling and water quality sampling.

Site name	Date Sampled	Latitude	Longitude
Station 4	7/18/16	46° 47.3' N	91° 57.8' W
Station 10	7/18/16	46° 55.0' N	91° 48.0' W
Station 2	7/18/16	47° 3.9' N	91° 25.9' W
Station 3	7/19/16	47° 19.0' N	89° 51.0' W
Station 8	7/20/16	47° 19.0' N	90° 32.6' W
Station 5	7/20/16	46° 59.9' N	91° 22.6' W
Station 6	7/20/16	46° 56.4' N	91° 20.5' W
Station 7	7/20/16	46° 51.7' N	91° 17.0' W
Station 11	7/20/16	46° 50.0' N	91° 45.1' W

Table S-6. 2016 satellite data. Column headings are month/day.

k_d (1/m)	7/18	7/19	7/20
<i>Sites sampled</i>			
4	0.41	0.63	0.80
10		0.81	na
2	0.13	0.21	0.26
3	0.09		
8	0.15	0.13	0.11
5	0.11	0.19	0.19
6	0.17	0.32	0.35
7		0.55	0.82
11	0.32	0.48	0.53

Note: **Bold** indicates values for non-plume

Table S-7. CTD derived data for 2016 samplings.

Site	Depth Sampled (m)	WetStar chl _a (mg/m ³)	CDOM (mg/m ³)	Xmiss (%)
4	5	1.35	5.72	73.94
10	5	0.81	6.81	57.56
2	5	0.39	1.29	87.60
3	5	0.89	1.13	90.23
8	5	0.57	1.12	90.16
5	5	1.15	2.27	84.27
6	5	1.40	5.61	80.36
7	5	1.94	9.18	73.82
11	2	1.03	7.50	54.44

Note: The complete CTD data for these samplings can be found at the R2R website (http://www.rvdata.us/catalog/Blue_Heron). **Bold** indicates values for non-plume.

Table S-8. 2016 water quality data.

Site	Chla (ug/L) (n=2)	NH ₃ (ug/L)	DOC (mg/L) (n=3)	TDN (ug/L)	TP (ug/L)	n (TP)	TDP (ug/L)	n (TDP)	TIC (mg/L)	TOC (mg/L) (n=3)	pH (n=2)
4	1.00+/-0.04	5.62	1.69+/-0.02	5.04	2.2+/-1.3	7	1.0+/-0.8	5	9.43	1.90+/-0.02	7.886+/-0.000
10	0.7+/-0.1	6.82	1.90+/-0.01	6.02	2.2+/-0.4	7	1.0+/-0.5	3	9.50	1.89+/-0.02	7.852+/-0.003
2	0.98+/-0.04	1.53	1.29+/-0.01	5.74	2.5+/-1.8	4	2.5+/-1.1	5	9.27	1.33+/-0.03	7.908+/-0.000
3	0.76+/-0.02	Lost	1.15+/-0.01	5.46	2.2+/-1.9	8	1.7+/-1.1	8	9.23	1.33+/-0.01	7.940+/-0.001
8	0.69+/-0.02	2.39	1.31+/-0.01	5.74	.23+/-0.05	2	2.3+/-2.7	8	9.21	1.44+/-0.01	7.974+/-0.002
5	1.4+/-0.1	2.22	1.28+/-0.03	5.60	2.4+/-1.7	4	2.1+/-2.2	8	9.10	1.47+/-0.02	7.979+/-0.000
6	2.0+/-0.2	1.36	1.49+/-0.02	5.60	2.3+/-0.8	3	1.99+/-1.0	8	9.01	1.54+/-0.03	7.972+/-0.006
7	1.85+/-0.03	2.90	1.80+/-0.01	5.32	1.4+/-0.4	3	2.2+/-1.3	4	9.41	1.83+/-0.02	7.832+/-0.001
11	1.25+/-0.04	3.75	1.75+/-0.03	5.74	4.3+/-2.5	3	3.0+/-1.7	8	9.42	1.73+/-0.03	7.917+/-0.002

Note: **Bold** indicated values for non-plume, italicized values are +/- are standard deviations, non italicized +/- are average deviations

References:

Minor, E. C., Forsman, B., & Guildford, S. J. (2014), The effect of a flood pulse on the water column of western Lake Superior, USA. *Journal of Great Lakes Research*, 40(2), 455-462