



Figure. S1 Temporal variations in the precipitation (bar chart) and flow rates (blue line) of the stream water during storm events II (a) and III (f), together with those in the concentrations of nitrate (orange circles) and the values of $\delta^{15}\text{N}$ (b and g), $\delta^{18}\text{O}$ (c and h), and $\Delta^{17}\text{O}$ (d and i) of nitrate, and $[\text{NO}_3^-]_{\text{atm}}$ (e and j) in the stream water (blue circles).

The error bars smaller than the sizes of the symbols are not presented.

Table S1. Flow rates, concentrations, and isotopic compositions of stream nitrate during routine observation.

	Flow rate L/min	NO ₃ ⁻ μM	δ ¹⁵ N(NO ₃ ⁻) /10 ³	δ ¹⁸ O(NO ₃ ⁻) /10 ³	Δ ¹⁷ O(NO ₃ ⁻) /10 ³
2017/5/31	61.4	39.9	+2.96	+0.55	+1.59
2017/6/30	56.0	38.2	+4.54	+3.25	+1.80
2017/7/31	83.9	47.1	+1.79	+1.99	+2.11
2017/8/31	114.2	58.4	+5.43	+2.11	+1.48
2017/9/29	89.7	47.1	+0.72	+0.02	+1.21
2017/10/31	86.8	56.6	+2.45	+0.79	+1.10
2017/11/30	136.7	74.0	+1.98	+0.41	+0.45
2017/12/28	180.9	59.5	+2.51	+1.70	+1.34
2018/2/5	161.8	43.8	—	—	—
2018/2/28	952.2	45.4	+2.87	+2.59	+1.14
2018/3/30	140.0	48.2	+0.06	+1.04	+1.45
2018/4/27	126.9	43.5	+1.19	+1.10	+1.20
2018/5/31	104.8	42.3	+1.23	+0.88	+1.38
2018/6/29	83.9	38.7	+1.75	+1.32	+1.44
2018/7/30	53.4	35.7	+5.91	+4.14	+1.49
2018/8/31	216.9	129.3	+1.76	-1.90	+0.36
2018/9/28	75.2	51.3	+3.19	+0.94	+0.90
2018/10/31	86.8	62.6	+1.62	-0.31	+0.73
2018/11/30	72.4	54.3	+1.17	+0.76	+0.91
2018/12/28	111.0	70.0	+2.17	+0.61	+1.17
2019/1/31	117.3	62.4	+1.27	+7.71	+2.73
2019/2/28	92.7	56.1	+2.89	+2.53	+1.50
2019/3/29	72.4	48.3	+1.56	+2.54	+1.62
2019/4/25	98.7	43.1	+1.01	+1.47	+1.35
2019/5/31	71.0	40.4	+0.72	+0.91	+1.13
2019/6/28	73.2	41.1	+1.11	+0.52	+1.10
2019/7/31	61.6	39.5	+1.55	+0.66	+1.06
2019/8/30	66.0	44.9	+2.07	-0.13	+0.91
2019/9/30	28.0	37.9	+1.65	+1.56	+1.36
2019/10/31	32.6	50.4	+1.04	+0.19	+0.92
2019/11/29	45.0	67.1	+1.08	-0.31	+0.71
2019/12/27	62.9	79.0	+0.65	-0.39	+0.45
2020/1/31	61.8	56.5	+0.73	-0.20	+0.71
2020/2/28	65.5	69.5	+0.76	+0.32	+0.98
2020/3/31	71.1	62.6	+0.74	+0.14	+0.62

—No sample

Table S2. Flow rates, precipitations, concentrations, and isotopic compositions of stream nitrate during storm event I (2019/8/22).

	Flow rate L/min	Precipitation mm	NO ₃ ⁻ μM	δ ¹⁵ N(NO ₃ ⁻) /10 ³	δ ¹⁸ O(NO ₃ ⁻) /10 ³	Δ ¹⁷ O(NO ₃ ⁻) /10 ³
16:00	64.1	0	24.7	+2.32	+2.17	+1.33
17:00	64.1	0	29.2	+1.79	+2.82	+1.25
18:00	64.1	0	34.5	+1.35	+2.14	+1.25
19:00	64.1	0	33.7	+2.00	+2.40	+1.60
20:00	64.1	0	32.5	+2.52	+1.63	+1.41
21:00	64.1	0	32.7	+2.33	+2.47	+1.07
22:00	61.4	0	32.5	+2.33	+2.47	+0.93
23:00	61.4	0	32.5	+2.27	+2.65	+1.25
0:00	58.7	0	32.7	+2.08	+2.26	+1.21
1:00	61.4	0	32.3	+2.28	+3.11	+1.52
2:00	64.1	1	31.9	+1.92	+1.99	+1.60
3:00	72.4	3	33.7	+1.24	+1.24	+1.17
4:00	83.9	11	37.2	+1.42	+0.16	+1.42
5:00	198.7	12	75.8	+0.21	-2.02	+0.64
6:00	281.4	20	122.6	+0.00	-3.34	+0.31
7:00	209.6	2.5	110.6	-0.13	-3.34	+0.32
8:00	153.3	0.5	88.9	+0.91	-2.34	+0.50
9:00	120.5	0.5	74.4	+0.91	-2.04	+0.69
10:00	104.8	1	66.9	+1.34	-1.19	+0.52
11:00	228.0	10	97.9	+0.29	-1.30	+0.74
12:00	167.0	0	97.3	+0.64	-1.91	+0.51
13:00	133.4	0	86.7	+0.79	-2.18	+0.47
14:00	111.0	0	76.6	+0.86	-1.81	+0.51
15:00	92.7	0	69.3	+1.36	-1.42	+0.52

Table S3. Flow rates, precipitations, concentrations, and isotopic compositions of stream nitrate during storm event II (2019/10/12).

	Flow rate	Precipitation	NO ₃ ⁻	δ ¹⁵ N(NO ₃ ⁻)	δ ¹⁸ O(NO ₃ ⁻)	Δ ¹⁷ O(NO ₃ ⁻)
	L/min	mm	μM	/10 ³	/10 ³	/10 ³
15:00	22.4	0	28.7	+1.61	+2.18	+1.35
16:00	18.3	0.5	34.9	+1.26	+1.51	+1.24
17:00	29.0	2	35.4	+2.96	+2.85	+1.07
18:00	45.7	8.5	44.4	+1.38	+0.34	+0.88
19:00	48.2	6	51.2	+2.40	+0.25	+0.87
20:00	58.7	7.5	59.0	+0.51	-0.31	+0.68
21:00	69.6	7	70.5	+0.95	-1.35	+0.47
22:00	95.7	6	88.6	-0.06	-1.88	+0.42
23:00	104.8	4.5	-	-	-	-
0:00	107.9	4.5	127.2	-0.43	-2.42	+0.49
1:00	95.7	5.5	128.9	+0.07	-1.93	+0.26
2:00	83.9	2	134.1	-0.22	-2.56	+0.35
3:00	69.6	0.5	129.0	-0.10	-2.05	+0.41
4:00	61.4	0	124.1	-0.08	-1.85	+0.35
5:00	58.7	0	117.4	+0.61	-1.08	+0.38
6:00	50.8	0	110.9	+0.35	-1.96	+0.29
7:00	50.8	1	104.7	+0.28	-2.05	+0.54
8:00	45.7	0.5	100.1	+0.43	-1.66	+0.59
9:00	40.7	0.5	94.9	-0.50	-1.30	+0.60
10:00	43.2	0	90.7	+0.25	-1.68	+0.60
11:00	45.7	0	86.9	+0.67	-0.80	+0.73
12:00	40.7	0	82.8	+0.77	-0.69	+0.76
13:00	40.7	0	79.8	+0.62	-0.62	+0.79
14:00	38.3	0	75.4	+0.54	-1.09	+0.93

- No sample

Table S4. Flow rates, precipitations, concentrations, and isotopic compositions of stream nitrate during storm event III (2020/9/13).

	Flow rate L/min	Precipitation mm	NO ₃ ⁻ μM	δ ¹⁵ N(NO ₃ ⁻) /10 ³	δ ¹⁸ O(NO ₃ ⁻) /10 ³	Δ ¹⁷ O(NO ₃ ⁻) /10 ³
11:00	111.0	0	46.6	+2.42	+1.74	+1.17
12:00	117.3	0	48.0	+3.54	+2.12	+1.10
13:00	111.0	0	46.3	+3.00	+1.53	+1.10
14:00	123.7	1	48.4	+1.70	+0.87	+1.12
15:00	184.4	20	48.1	+2.40	+1.13	+1.00
16:00	150.0	7.5	51.5	+2.34	+0.61	+0.88
17:00	235.4	10	56.2	+1.59	+0.18	+0.81
18:00	353.9	11.5	77.1	+1.01	-0.88	+0.80
19:00	277.5	1.5	114.5	-0.13	-2.19	+0.52
20:00	209.6	2	107.3	+0.49	-0.97	+0.61
21:00	180.9	1	95.7	+0.98	-1.57	+0.65
22:00	198.7	0	86.1	+1.61	-1.21	+0.73
23:00	205.9	7.5	92.3	+0.48	-1.88	+0.49
0:00	191.5	4.5	87.3	+1.60	-1.32	+0.58
1:00	195.1	3.5	87.1	+1.52	-0.53	+0.75
2:00	209.6	2	93.4	+1.18	-1.33	+0.78
3:00	209.6	2	95.9	+1.99	-1.10	+0.79
4:00	202.3	2.5	98.4	+0.96	-1.66	+0.60
5:00	195.1	0	97.1	+0.69	-2.25	+0.57
6:00	184.4	0	94.8	+1.72	-0.71	+0.73
7:00	180.9	0	92.4	+1.55	-1.46	+0.49
8:00	177.4	0	89.9	+1.89	-0.92	+0.52
9:00	173.9	0	87.2	+1.52	-1.24	+0.66
10:00	170.4	0	85.7	+1.84	+0.02	+0.52