



Supplement of

Impacts of different types of El Niño events on water quality over the Corn Belt, United States

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1 **Table S1.** Best estimates of hydrologic parameters at the Ohio-Tennessee River Basin (OTRB)
 2 and Upper Mississippi River Basin (UMRB).

Calibration Points	CN2	SOL_AWC(1) ^a	ESCO	GW_DELAY	ALPHA_BF	GWQMN	GW_REVAP	RCHRG_DP
Allowable range	-5-5	-0.2-0.2	0.7-1	0-300	0-1	0-300	0.02-0.2	0-0.5
Greenup	-5	-0.2	0.7	16	0.51	161	0.1	0.2
Markland	5	-0.2	0.98	16	0.51	161	0.1	0.2
Riverton	-5	-0.14	0.9	33	0.58	20	0.07	0.2
Old Hickory	-4	0.12	0.7	50	0.17	250	0.18	0.24
Cannelton	5	-0.05	0.98	13.5	0.14	30	0.03	0.2
Metropolis	-1	0.05	0.95	58.5	0.75	155	0.05	0.2
Chattanooga	-5	0.2	0.88	300	0.17	119	0.18	0.24
Royalton	-5	0.17	0.7	125	0.4	200	0.05	0.1
Jordan	0	0.05	0.85	60	0.8	150	0.1	0.1
Durand	-5	0.2	0.7	200	0.8	60	0.1	0.1
Clinton	-5	0.2	0.7	200	0.6	210	0.1	0.1
Augusta	5	-0.1	0.8	20	0.38	200	0.12	0.31
Wapello	0	0	0.87	94	0.53	200	0.16	0.01
Keosauqua	-5	-0.1	0.7	66	0.39	282	0.16	0.01
Grafton	5	0.18	0.82	50	0.64	200	0.12	0.05

3 ^a For SOL_AWC(1), allowable ranges and best estimates show the change from the default value as a fraction, for
 4 example, 0.1 corresponds to 10% increase and the allowable change of the parameters was within -0.2 and 0.2 of
 5 the default values.

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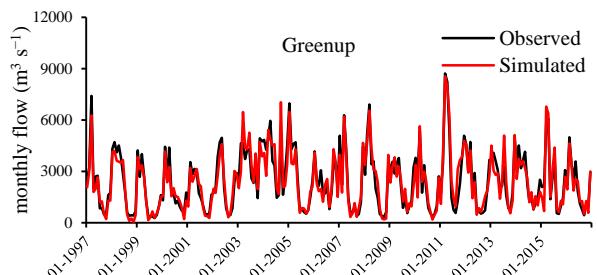
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9 **Table S2.** Best estimates of total suspended sediment (TSS), total nitrogen (TN), and total
 10 phosphorus (TP) parameters at the OTRB and UMRB.

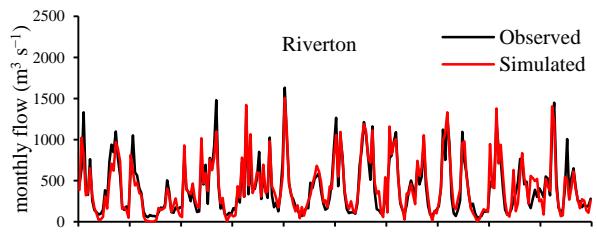
Basin	Variable	Calibration Points	Definition	Allowable range	Value
OTRB	TSS	USLE_P	USLE equation support pra	0-1	0.75
	TN	ERORGN	Organic N enrichment ratio	0-5	5
		NPERCO	Nitrogen percolation coefficient	0-1	0.5
	TP	ERORGP	Organic P enrichment ratio	0-5	0.6
		PPERCO	Phosphorus percolation coefficient	10-17.5	10
UMRB	TSS	USLE_P	USLE equation support pra	0-1	0.7
		SPEXP	Exponent parameter for calculating sediment reentrained in channel sediment routing1	1-1.5	1.5
		SPCON	Linear parameter for calculating the maximum amount of sediment that can be reentrained during channel sediment routing	0.0001-0.01	0.00015
		CH_COV1	Channel erodibility factor	0-0.6	0.3
	TN	CH_COV2	Channel cover factor	0-1	0.5
		ERORGN	Organic N enrichment ratio	0-5	5
		NPERCO	Nitrogen percolation coefficient	0-1	0.2
	TP	ERORGP	Organic P enrichment ratio	0-5	0.5
		PPERCO	Phosphorus percolation coefficient	10-17.5	10

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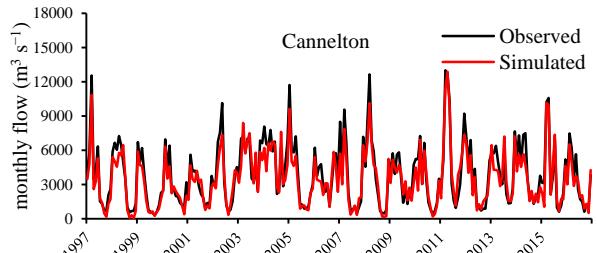
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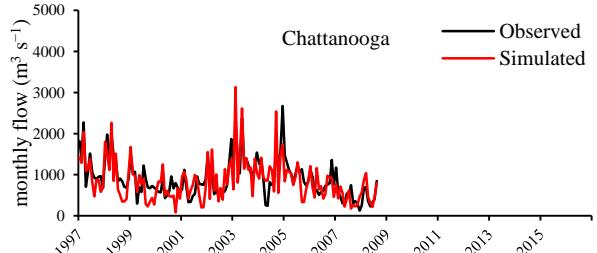
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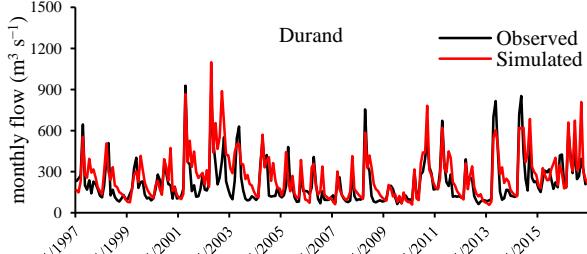
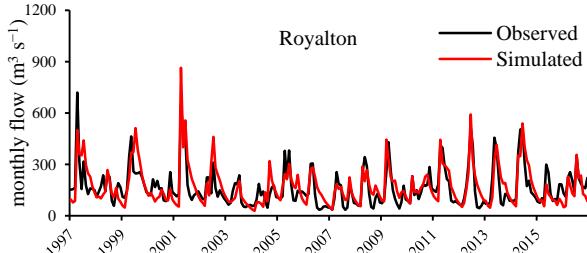
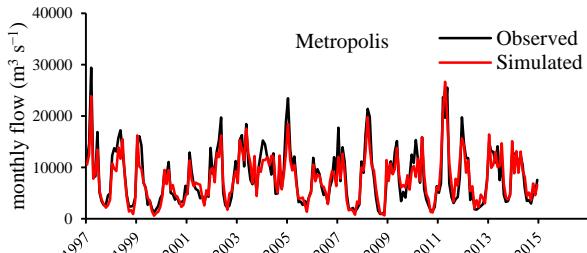
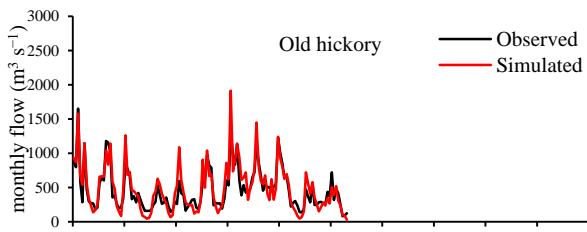
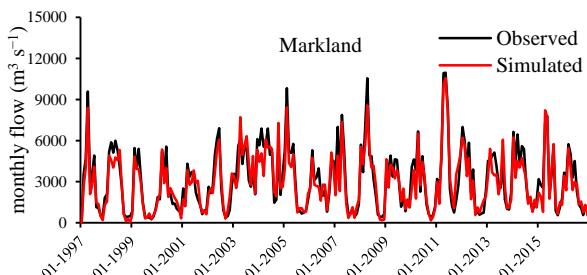
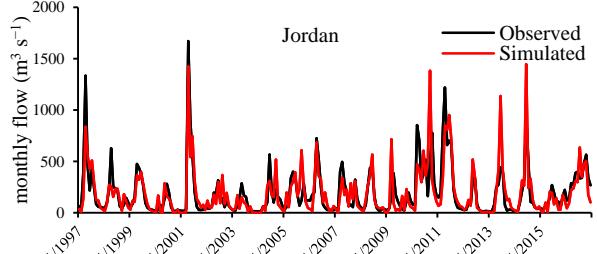
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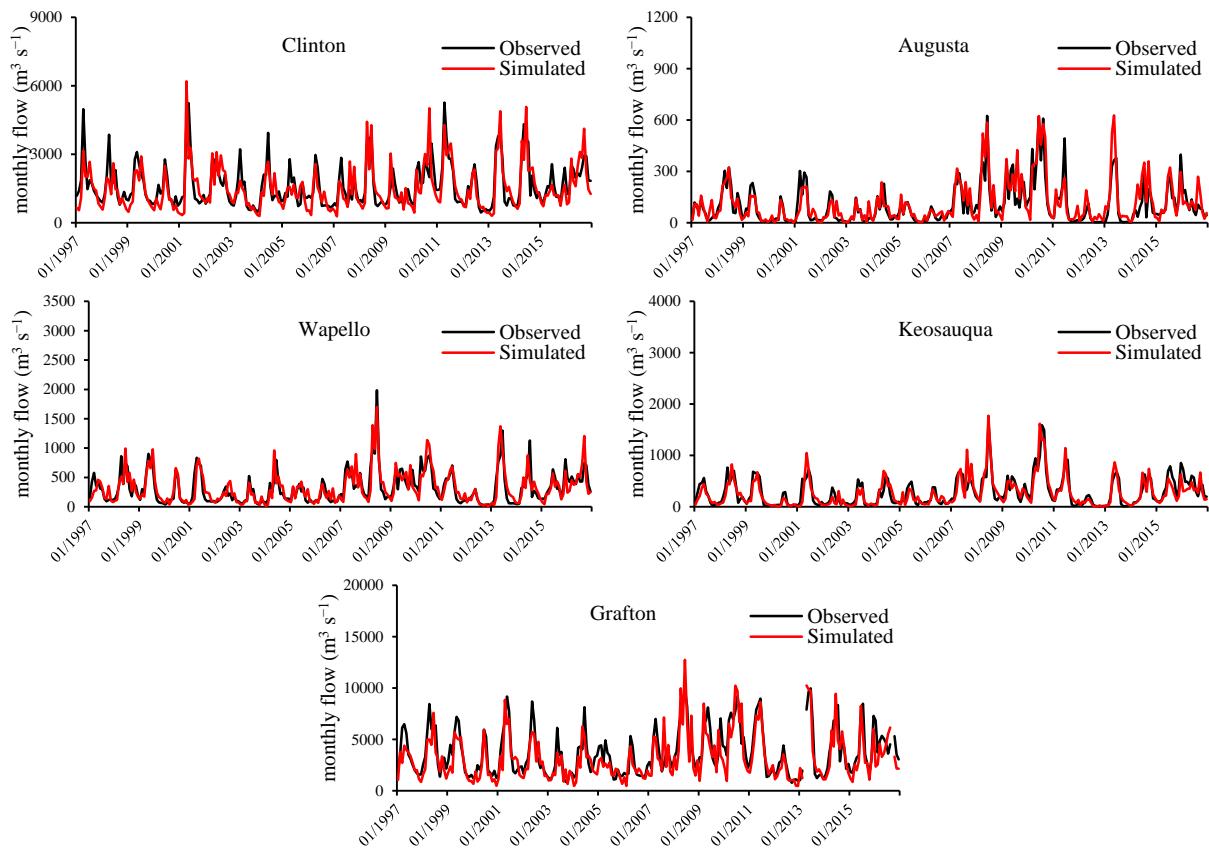
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27 **Figure S1.** Monthly simulated versus observed flows (unit: $\text{m}^3 \text{s}^{-1}$) during calibration period
28 (1997–2016) at the OTRB and UMRB.

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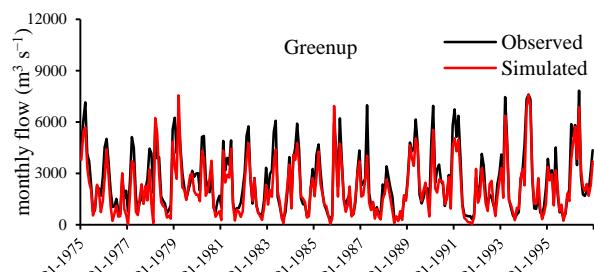
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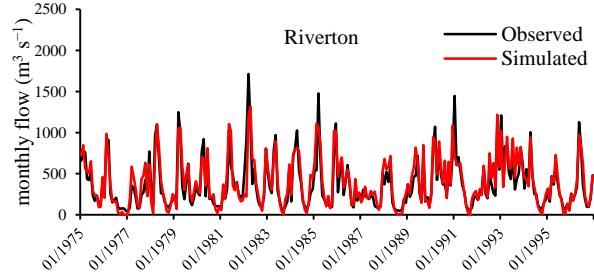
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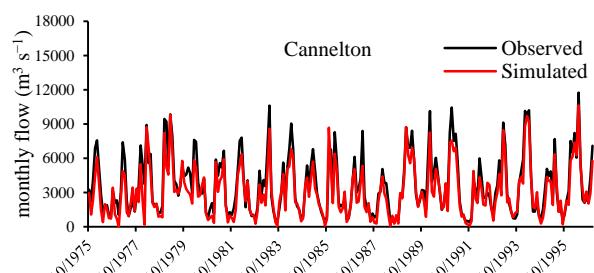
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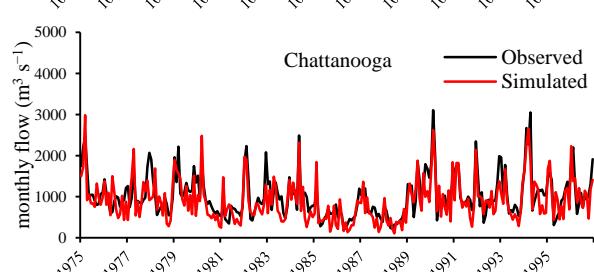
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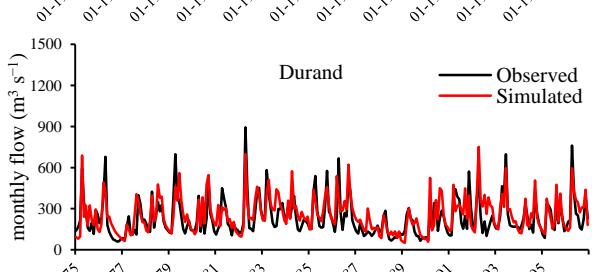
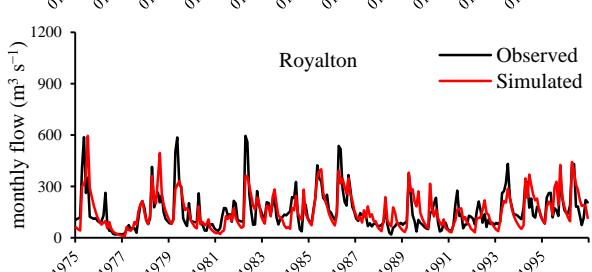
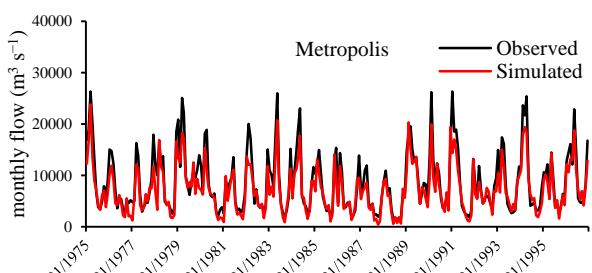
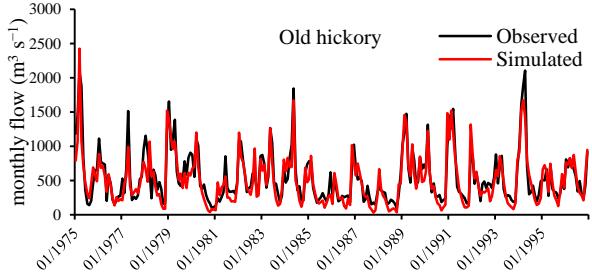
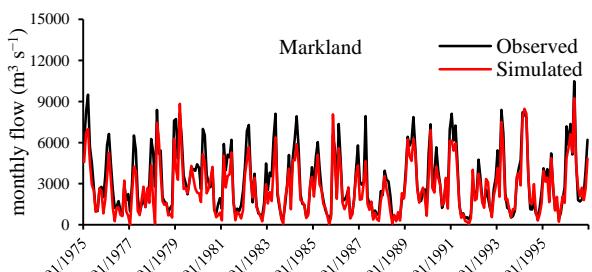
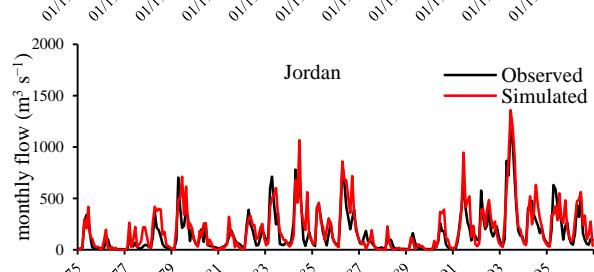
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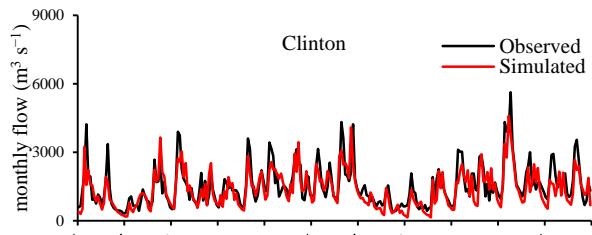
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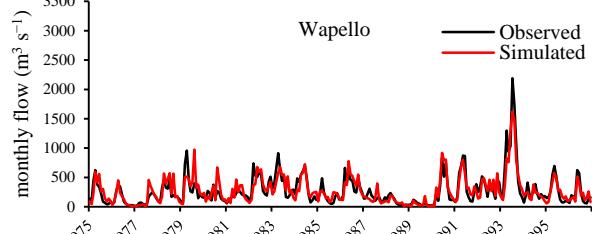
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42 **Figure S2.** Monthly simulated versus observed flows (unit: $\text{m}^3 \text{s}^{-1}$) during validation period
 43 (1975–1996) at the OTRB and UMRB.

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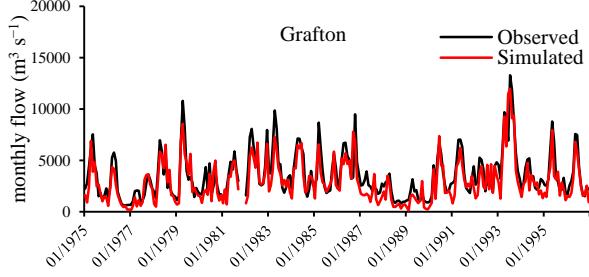
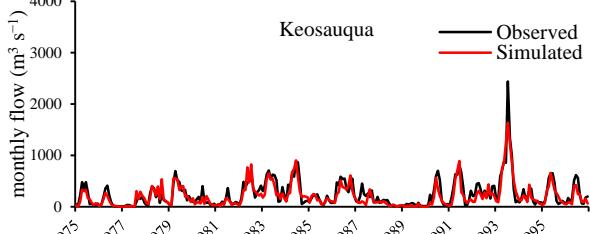
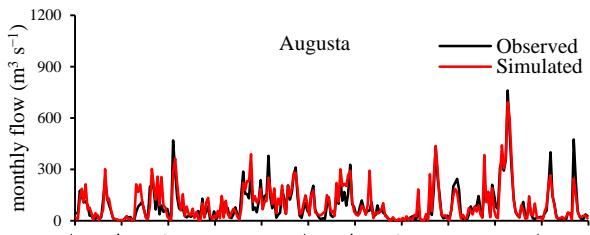
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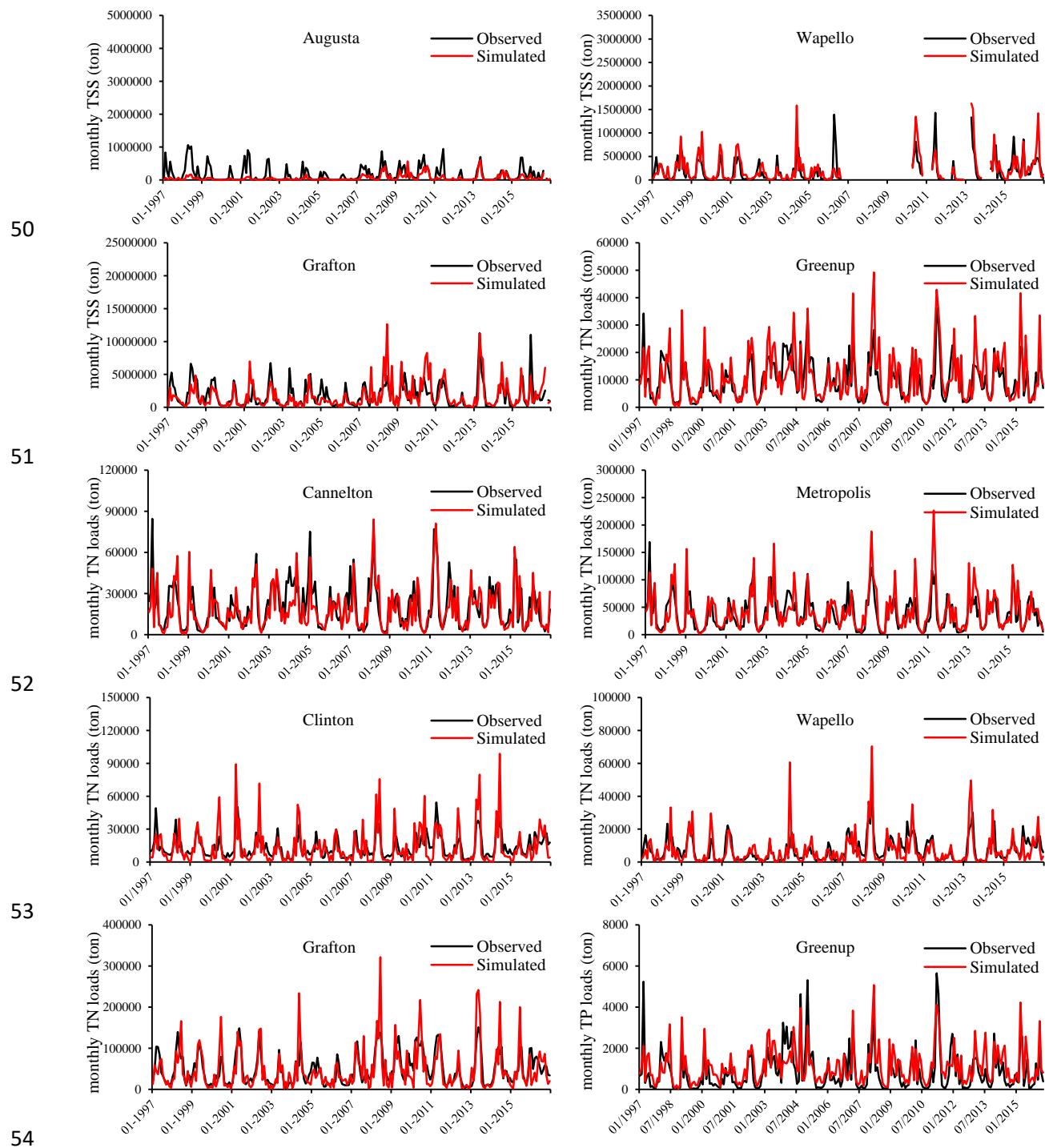
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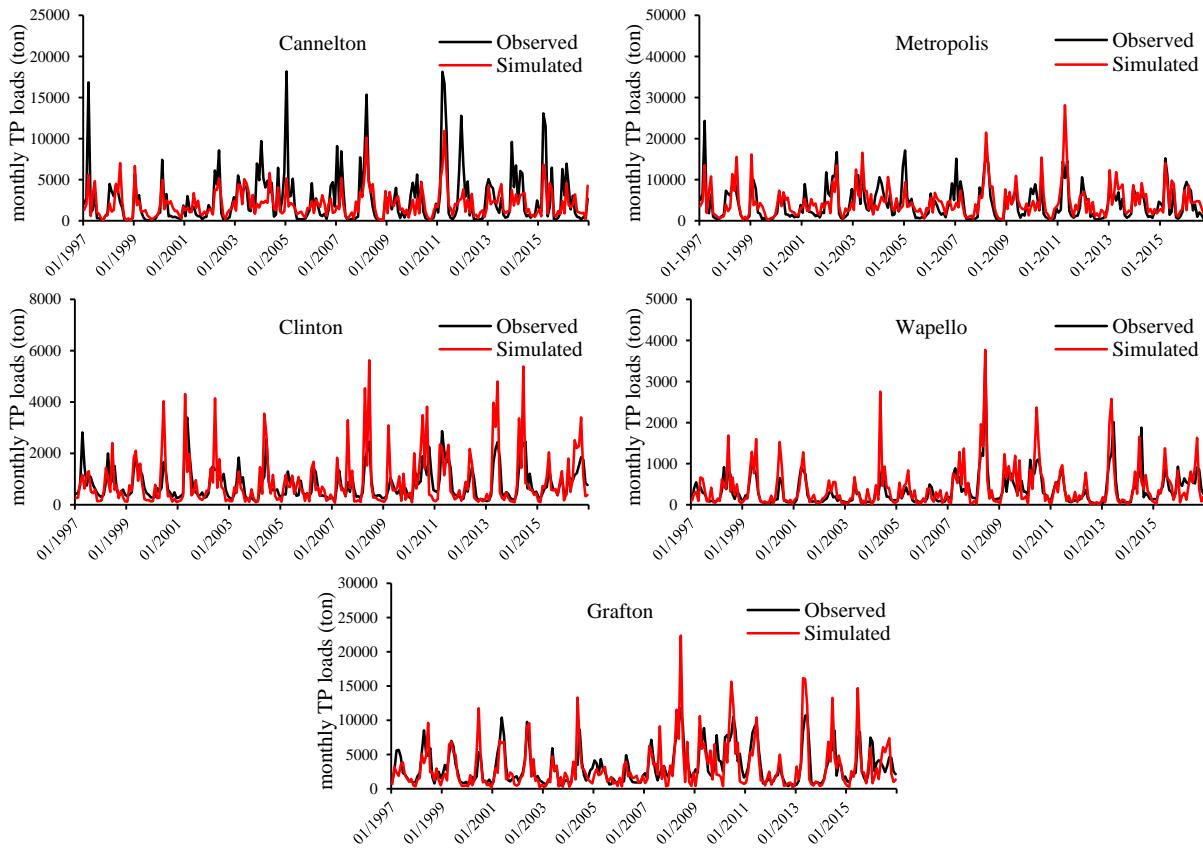
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58 **Figure S3.** Monthly simulated versus observed TSS, TN, and TP (unit: metric ton) during
 59 calibration period (1997–2016) at the OTRB and UMRB.

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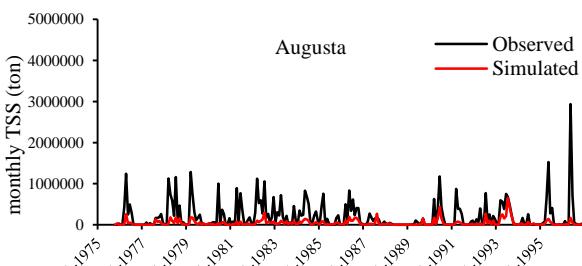
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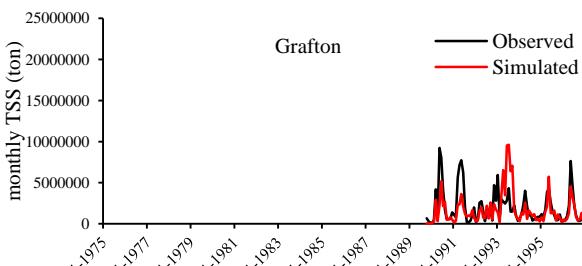
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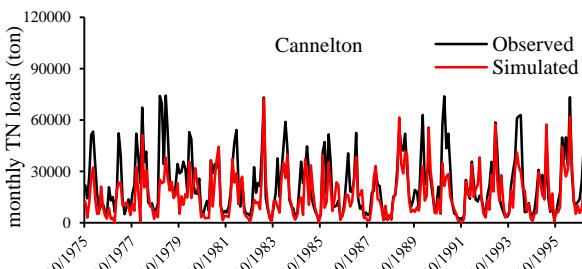
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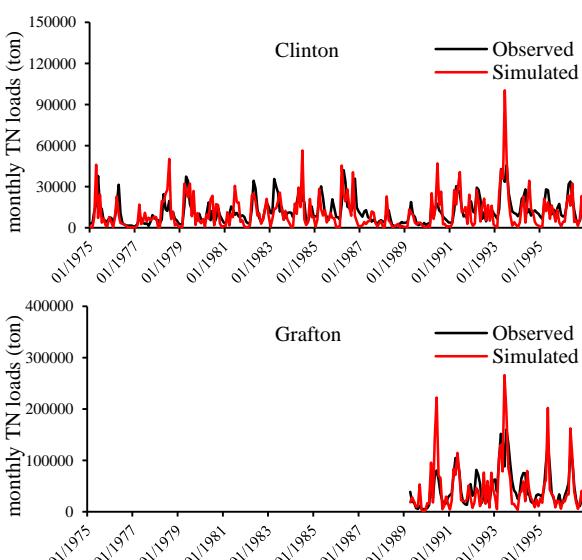
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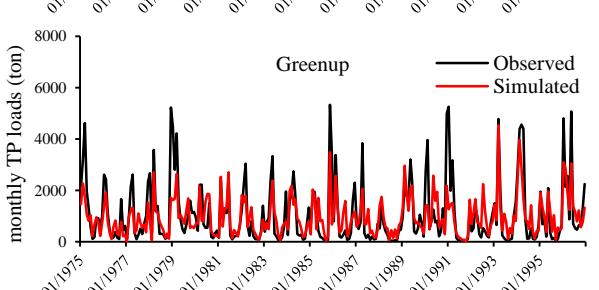
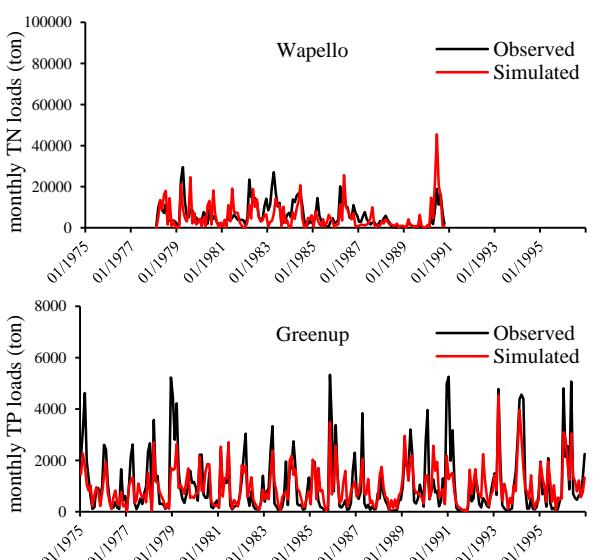
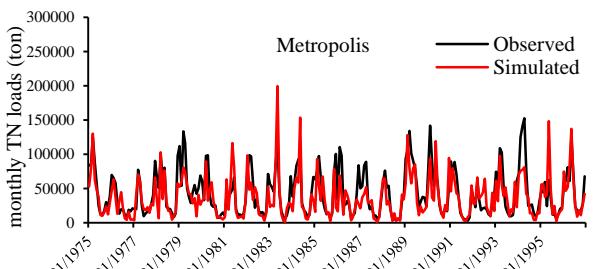
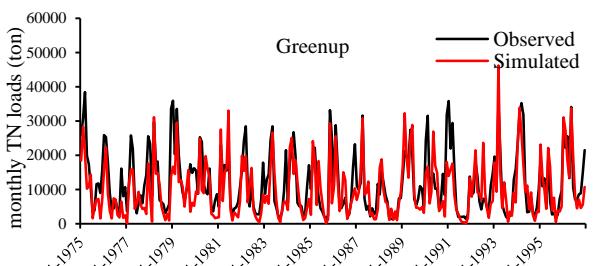
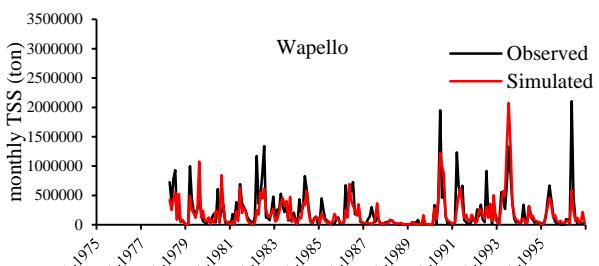
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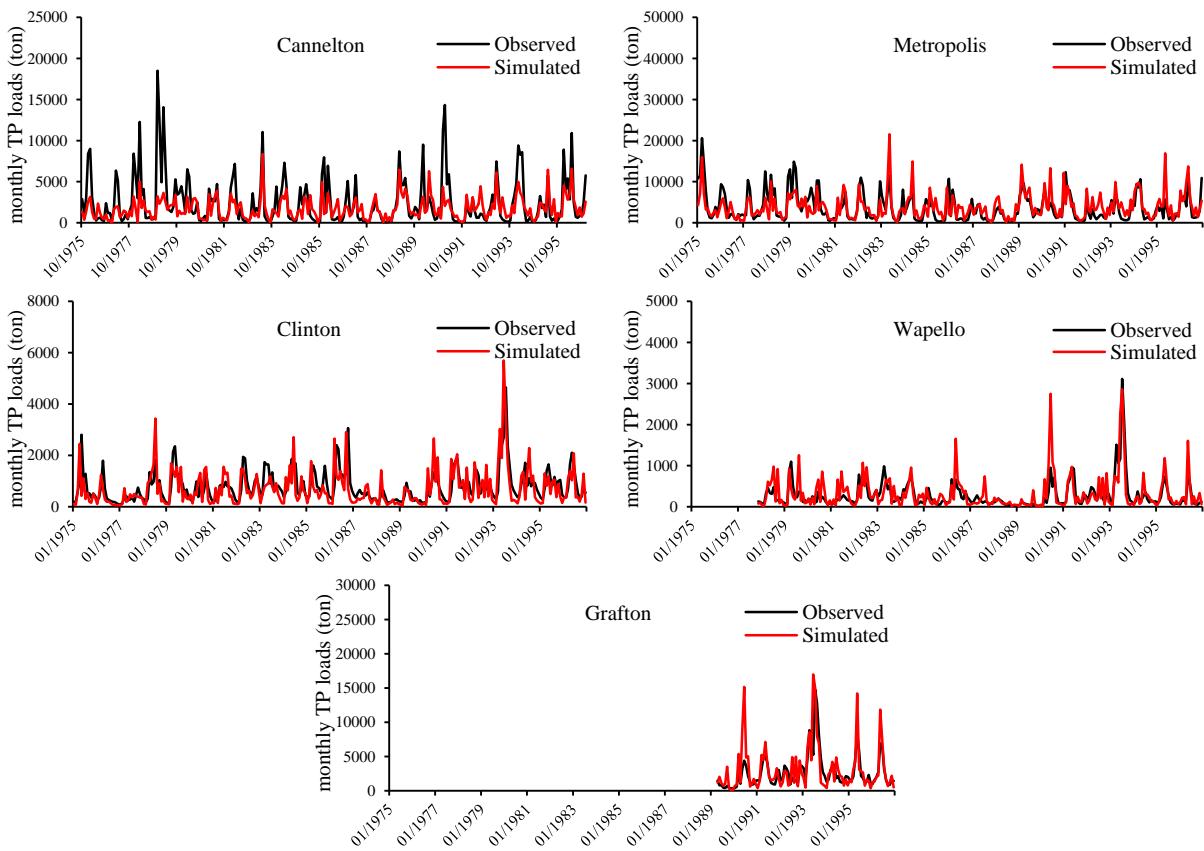
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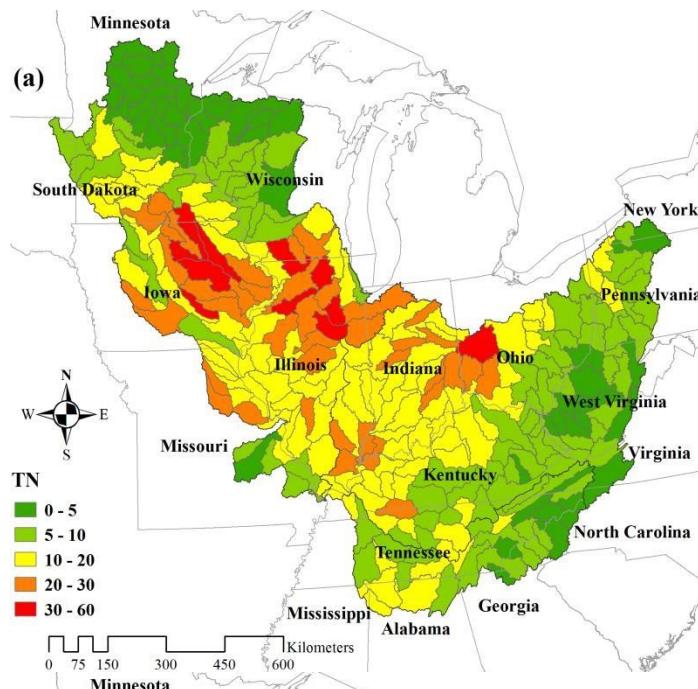
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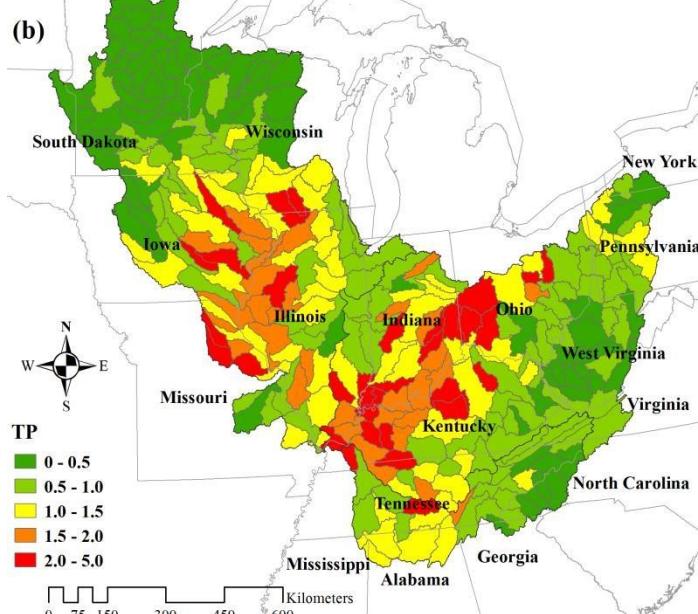
80 **Figure S4.** Monthly simulated versus observed TSS, TN, and TP (unit: metric ton) during
 81 validation period (1975–1996) at the OTRB and UMRB.

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85 **Figure S5.** Spatial distributions of annual (a) TN, (b) TP (unit: kg ha^{-1}) at the OTRB and UMRB.

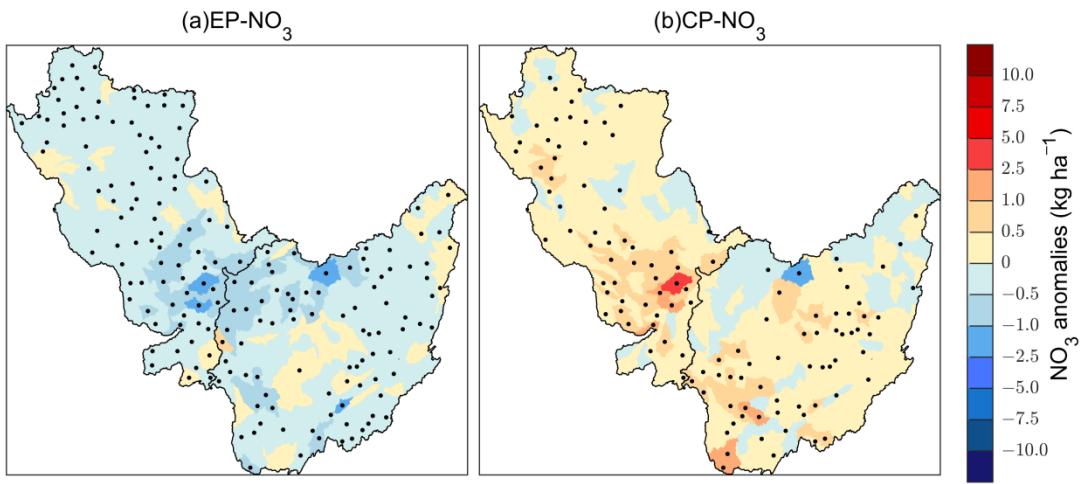
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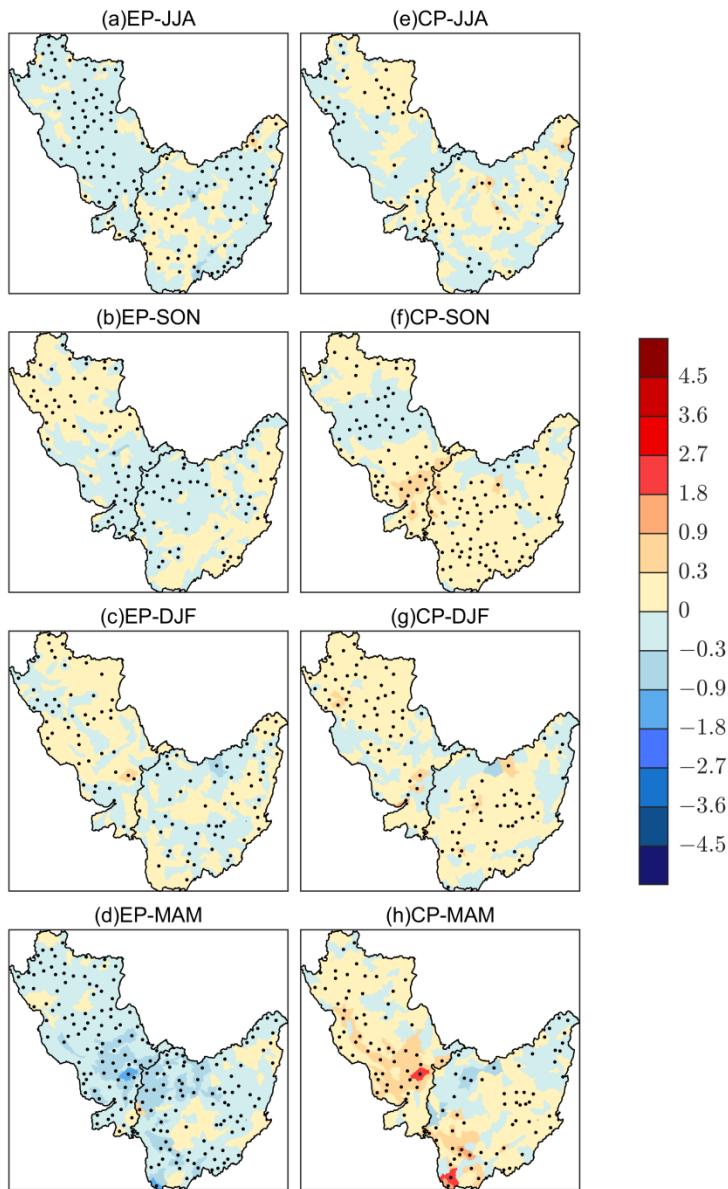
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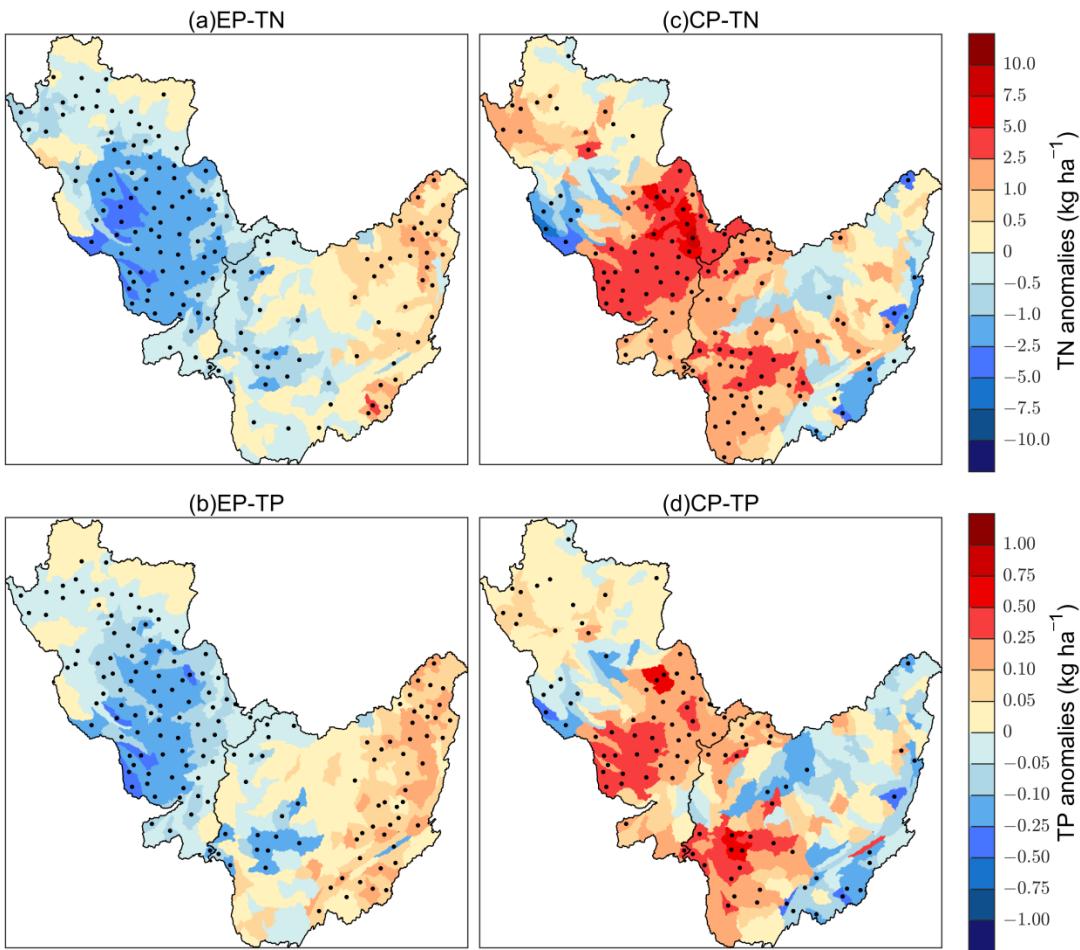


91 **Figure S6.** Composite results of annual nitrate (NO₃) anomalies (unit: kg ha⁻¹) in EP-El Niño
92 years (a) and in CP-El Niño years (b) during the period of 1975–2016. Stippling denotes
93 anomalies significantly different from zero at the 95% confidence level based on the Monte
94 Carlo test.



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96 **Figure S7.** Seasonal composite of nitrate (NO_3) anomalies (unit: kg ha^{-1}) in summer (JJA) (a),
 97 autumn (SON) (b), winter (DJF) (c), and spring (MAM) (d) in EP-El Niño years during the
 98 period of 1975–2016; (e-h) are the same as (a-d) but for CP-El Niño years. Stippling denotes
 99 anomalies significantly different from zero at the 95% confidence level based on the Monte
 100 Carlo test.



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102 **Figure S8.** Composite results of annual TN and TP anomalies (unit: kg ha^{-1}) in eastern Pacific
103 (EP)-El Niño years (a and b) and in central Pacific (CP)-El Niño years (c and d) during the
104 period of 2050–2099. Stippling denotes anomalies significantly different from zero at the 95%
105 confidence level based on the Monte Carlo test.
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