Supplementary material for:

Enhanced Watershed Modeling by Incorporating Remotely Sensed Evapotranspiration and Leaf Area Index

Corresponding author: Sangchul Lee (sangchul.lee84@gmail.com & slee2020@uos.ac.kr)

Contents of this file

Tables S1 – S4.

Figs. S1 – S3.

Table S1. Management schedules (adapted from Lee et al. (2016))

Crop	Planting	Fertilizer	Harvest
Corn (after corn)	Apr. 30 (no-till)	157 kg N ha^{-1} of poultry manure on Apr. 20 45 kg N ha^{-1} of sidedress 30% UAN on Jun. 7	Oct. 3
Corn (after Soybean and Double crop soybean)	Apr. 30 (no-till)	124 kg N ha^{-1} of poultry manure on Apr. 20 34 kg N ha^{-1} of sidedress 30% UAN on Jun. 7	Oct. 3
Soybean	May 20 (no-till)		Oct. 15
Double crop winter wheat (Dbl WW)	Oct. 10	34 kg N ha^{-1} of sidedress 30% UAN on Oct. 8 45 kg N ha^{-1} of sidedress 30% UAN on Mar. 1 67 kg N ha^{-1} of sidedress 30% UAN on Apr. 5	Jun. 27
Double crop soybean (Dbl Soyb)	Jun. 29		Nov. 1

Note: UAN stands for Urea-Ammonium Nitrate. The typical nitrogen content for poultry manure is assumed as 2.8% (Yeo et al., 2014).

Table S2. Parameter values for the PARs-1 and PARs-2

Parameter	1	2	3	4	5	6	7	8	9	10	11	12
CN	7	-1	12	12	-16	5	9	19	-19	-2	-10	18
GW_DELAY	40.37	5.68	20.90	90.44	63.09	35.45	90.03	76.38	5.31	97.03	21.19	73.02
ALPHA_BF	0.34	0.06	0.83	0.55	0.79	0.53	0.06	0.19	0.84	0.66	0.98	0.55
GWQMN	1532.40	771.10	1579.60	3211.80	1410.35	2.15	4297.35	3389.35	248.56	3301.50	2309.95	3257.75
GW_REVAP	0.03	0.16	0.11	0.06	0.06	0.05	0.05	0.11	0.16	0.09	0.16	0.11
REVAPMN	475.96	126.78	265.23	83.04	58.23	420.93	279.53	248.94	376.31	444.27	31.79	447.70
SOL_AWC	1.02	0.71	0.62	1.18	1.00	0.94	0.73	1.40	0.59	0.61	1.49	0.53
CH_K2	34.52	146.48	149.97	87.39	132.73	51.89	57.05	29.52	132.49	9.30	61.26	35.67
CH_N2	0.19	0.03	0.03	0.23	0.21	0.12	0.07	0.24	0.19	0.05	0.04	0.28
SURLAG	8.85	15.12	12.36	9.53	11.91	13.21	14.37	19.30	23.64	1.24	12.92	16.45
ESCO	0.14	0.47	0.37	0.07	0.95	0.61	0.45	0.14	0.03	0.65	0.89	0.81
EPCO	0.79	0.50	0.63	0.40	0.10	0.62	0.58	0.47	0.13	0.84	0.81	0.31
CANMX	0.96	0.53	0.10	0.41	0.44	0.61	0.15	0.20	0.35	0.10	0.36	0.11
BIO_E (corn)	33.31	16.97	53.04	48.08	43.47	26.72	39.65	31.79	53.18	48.43	34.99	31.82
HVSTI (corn)	0.62	0.42	0.58	0.45	0.43	0.48	0.67	0.63	0.50	0.58	0.59	0.49
BLAI (corn)	5.19	6.38	7.77	5.15	7.34	7.63	6.44	7.91	7.16	7.52	7.62	5.64
FRGRW1 (corn)	0.10	0.23	0.07	0.13	0.21	0.36	0.35	0.30	0.07	0.39	0.07	0.35
FRGRW2 (corn)	0.35	0.10	0.22	0.20	0.36	0.13	0.21	0.30	0.16	0.40	0.10	0.30
LAIMX1 (corn)	0.52	0.46	0.85	0.84	0.43	0.50	0.57	0.93	0.63	0.63	0.72	0.41
LAIMX2 (corn)	0.96	0.83	0.89	0.79	0.45	0.76	0.67	0.72	0.88	0.57	0.93	0.42
BIO_E (soybean)	12.46	38.18	15.02	30.25	23.47	23.42	23.62	18.22	21.71	13.25	34.83	25.49
HVSTI (soybean)	0.24	0.24	0.51	0.41	0.28	0.28	0.48	0.39	0.47	0.26	0.21	0.36
BLAI (soybean)	4.68	1.66	1.46	3.57	4.30	2.82	2.33	3.78	3.68	2.08	2.47	1.53
FRGRW1 (soybean)	0.29	0.08	0.07	0.24	0.12	0.39	0.18	0.31	0.13	0.12	0.35	0.19
FRGRW2 (soybean)	0.07	0.08	0.16	0.33	0.24	0.08	0.31	0.40	0.16	0.33	0.15	0.31
LAIMX1 (soybean)	0.54	0.72	0.72	0.50	0.95	0.53	0.71	0.63	0.83	0.89	0.69	0.61
LAIMX2 (soybean)	0.76	0.48	0.55	0.81	0.56	0.40	0.84	0.44	0.79	0.53	0.51	0.74

PARs-1 indicate the parameter sets (PARs) that result in acceptable daily performance measures for streamflow and ET. PARs-2 indicate the PARs with acceptable daily performance measures for streamflow, ET, and LAI. The column ("6") with the gray background is the PAR included in PARs-1, but excluded in PARs-1. In other word, the PAR showed acceptable performance measures for streamflow and ET, but unacceptable performance measures for LAI.

Table S3. KGE values for the sub-watershed-level ET for PARs-2.

Sub.	PAR#1	PAR#2	PAR#3	PAR#4	PAR#5	PAR#7	PAR#8	PAR#9	PAR#10	PAR#11	PAR#12
1	0.58	0.57	0.57	0.57	0.56	0.59	0.57	0.57	0.55	0.55	0.57
2	0.57	0.58	0.59	0.56	0.58	0.59	0.58	0.57	0.54	0.54	0.59
3	0.56	0.56	0.55	0.54	0.54	0.57	0.55	0.54	0.52	0.52	0.56
4	0.56	0.56	0.57	0.56	0.56	0.57	0.56	0.56	0.55	0.54	0.57
5	0.59	0.59	0.58	0.57	0.56	0.59	0.57	0.57	0.56	0.56	0.58
6	0.53	0.53	0.54	0.52	0.53	0.54	0.53	0.53	0.51	0.51	0.54
7	0.56	0.56	0.56	0.55	0.54	0.57	0.55	0.55	0.53	0.53	0.56
8	0.55	0.55	0.56	0.54	0.55	0.56	0.55	0.55	0.53	0.52	0.56
9	0.56	0.56	0.56	0.54	0.54	0.57	0.55	0.55	0.52	0.53	0.56
10	0.53	0.53	0.54	0.51	0.52	0.54	0.53	0.51	0.49	0.50	0.54
11	0.54	0.55	0.55	0.53	0.53	0.56	0.54	0.53	0.51	0.51	0.55
12	0.53	0.53	0.54	0.52	0.53	0.54	0.53	0.52	0.51	0.50	0.54
13	0.55	0.55	0.56	0.53	0.53	0.55	0.55	0.52	0.51	0.52	0.56
14	0.57	0.58	0.58	0.56	0.57	0.58	0.57	0.56	0.54	0.54	0.59
15	0.55	0.55	0.56	0.53	0.54	0.56	0.55	0.53	0.51	0.52	0.56
16	0.55	0.55	0.56	0.54	0.55	0.57	0.56	0.55	0.52	0.52	0.57
17	0.49	0.49	0.50	0.48	0.49	0.51	0.50	0.48	0.46	0.46	0.51
18	0.54	0.54	0.55	0.53	0.54	0.56	0.54	0.54	0.51	0.51	0.55
Median	0.55	0.55	0.56	0.54	0.54	0.56	0.55	0.54	0.52	0.52	0.56

PARs-2 indicate the eleven parameter sets (PARs) with acceptable daily performance measures for streamflow, ET, and LAI.

Table S4. KGE values of the sub-watershed-level LAI for PARs-2.

Sub.	1	2	3	4	5	7	8	9	10	11	12
1	0.71	0.69	0.68	0.70	0.71	0.68	0.68	0.71	0.69	0.70	0.69
2	0.57	0.60	0.59	0.55	0.58	0.59	0.58	0.52	0.55	0.56	0.60
3	0.73	0.65	0.62	0.73	0.77	0.70	0.63	0.71	0.67	0.69	0.68
4	0.64	0.65	0.65	0.63	0.64	0.65	0.64	0.62	0.63	0.63	0.65
5	0.60	0.35	0.33	0.60	0.65	0.50	0.38	0.67	0.46	0.51	0.42
6	0.65	0.67	0.67	0.64	0.65	0.67	0.66	0.63	0.64	0.64	0.66
7	0.70	0.66	0.64	0.69	0.72	0.69	0.64	0.66	0.66	0.67	0.68
8	0.62	0.63	0.63	0.61	0.62	0.63	0.63	0.60	0.61	0.61	0.63
9	0.74	0.73	0.68	0.75	0.77	0.79	0.69	0.66	0.71	0.73	0.76
10	0.72	0.57	0.55	0.71	0.75	0.62	0.57	0.74	0.64	0.67	0.62
11	0.64	0.60	0.58	0.63	0.66	0.63	0.58	0.60	0.60	0.62	0.63
12	0.65	0.58	0.58	0.64	0.65	0.60	0.59	0.66	0.61	0.62	0.60
13	0.64	0.56	0.53	0.62	0.64	0.61	0.55	0.60	0.57	0.60	0.60
14	0.53	0.55	0.48	0.55	0.61	0.65	0.50	0.45	0.52	0.54	0.60
15	0.71	0.58	0.55	0.70	0.74	0.63	0.58	0.72	0.64	0.66	0.63
16	0.58	0.62	0.59	0.57	0.61	0.64	0.59	0.54	0.55	0.56	0.62
17	0.59	0.62	0.61	0.58	0.60	0.61	0.60	0.55	0.58	0.58	0.62
18	0.66	0.69	0.68	0.65	0.70	0.70	0.66	0.63	0.64	0.65	0.69
Median	0.65	0.61	0.59	0.64	0.67	0.64	0.60	0.63	0.61	0.62	0.63

PARs-2 indicate the eleven parameter sets (PARs) with acceptable daily performance measures for streamflow, ET, and LAI.

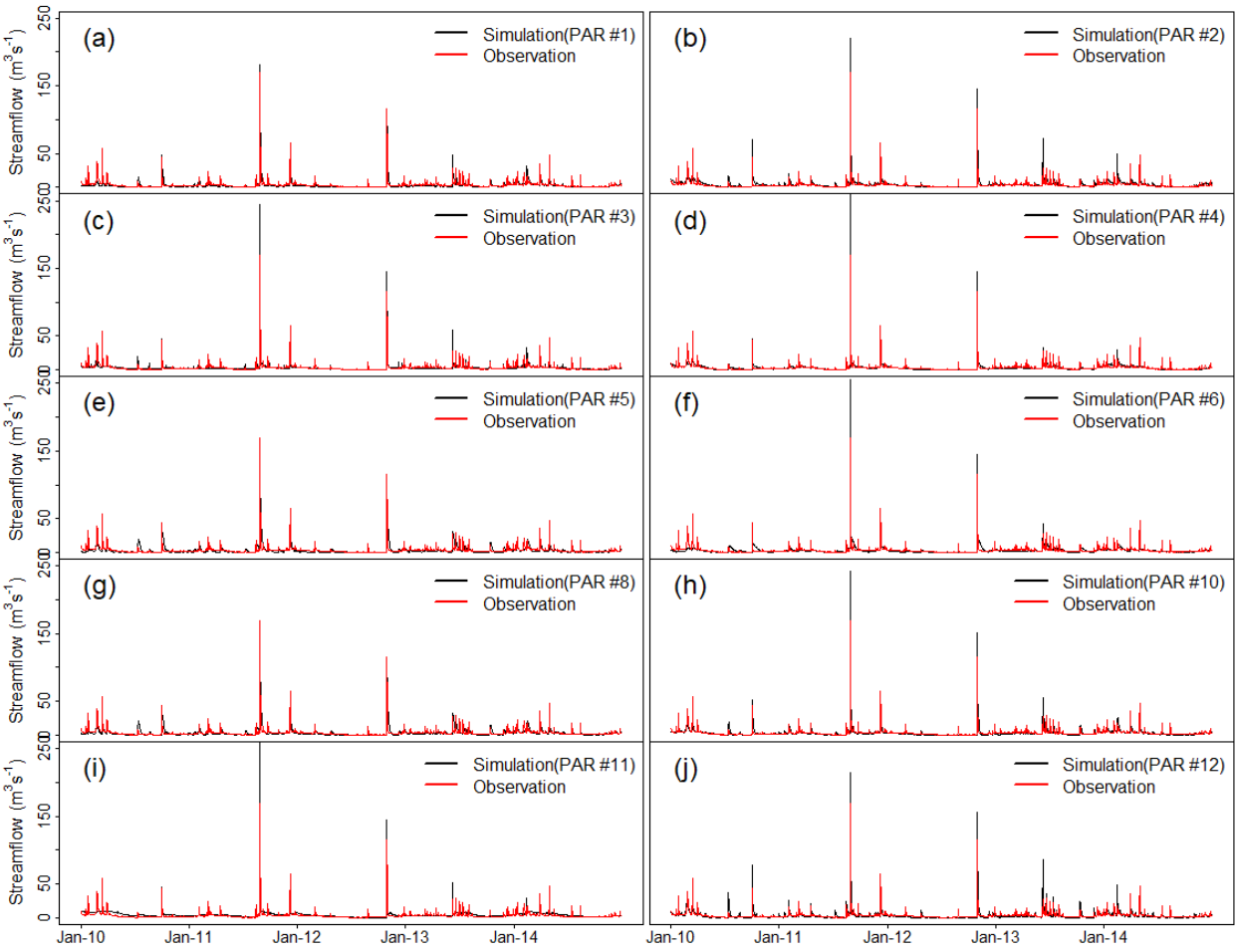

Fig. S1. Comparison of daily simulations with observed streamflow for ten acceptable parameter sets (PARs). Simulation results of PAR #7 and #9 are shown in Fig. 2 of the main manuscript.

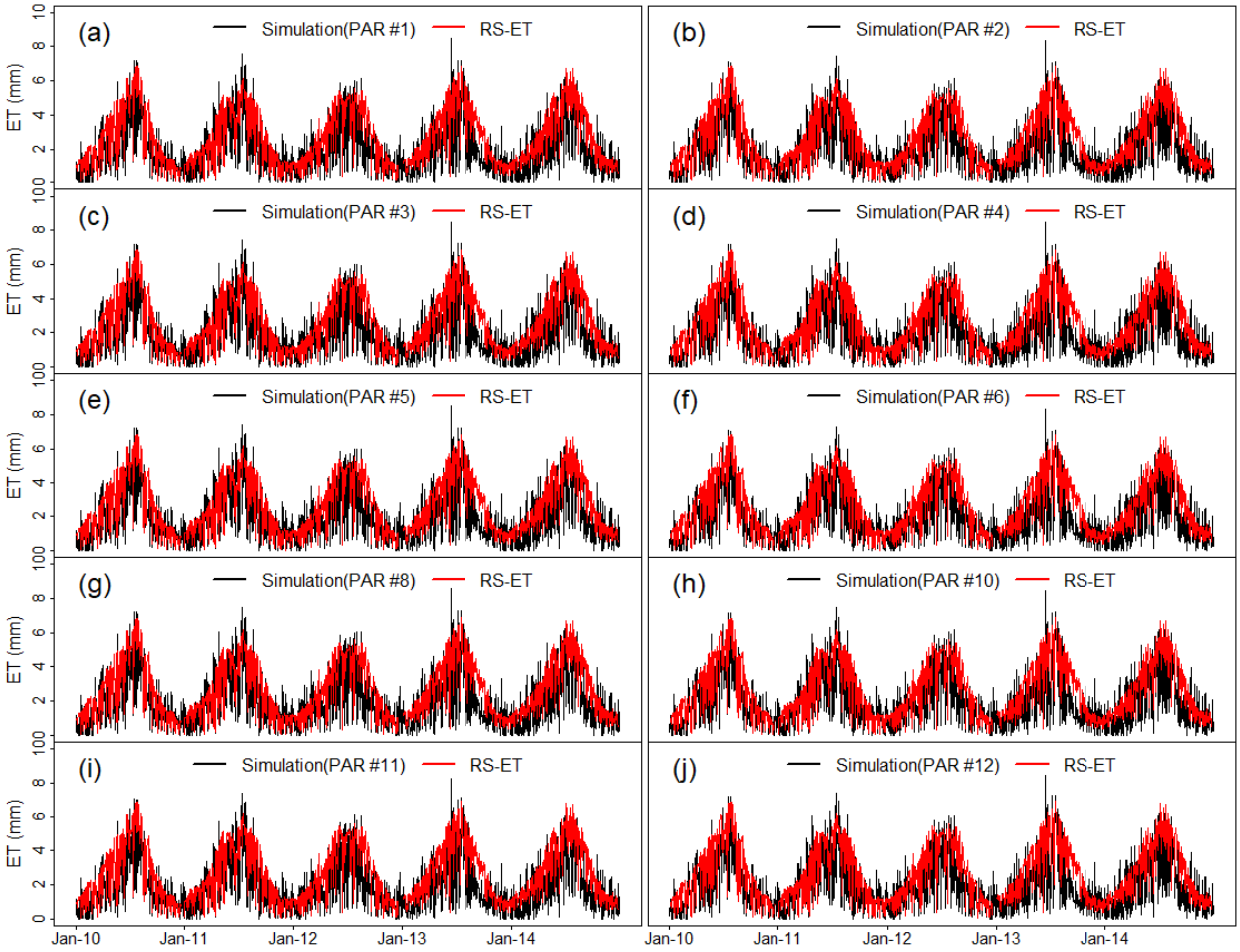

Fig. S2. Comparison of daily simulations with RS-ET for ten acceptable parameter sets (PARs). Simulations from PAR #7 and #9 are shown in Fig. 2 of the main manuscript.

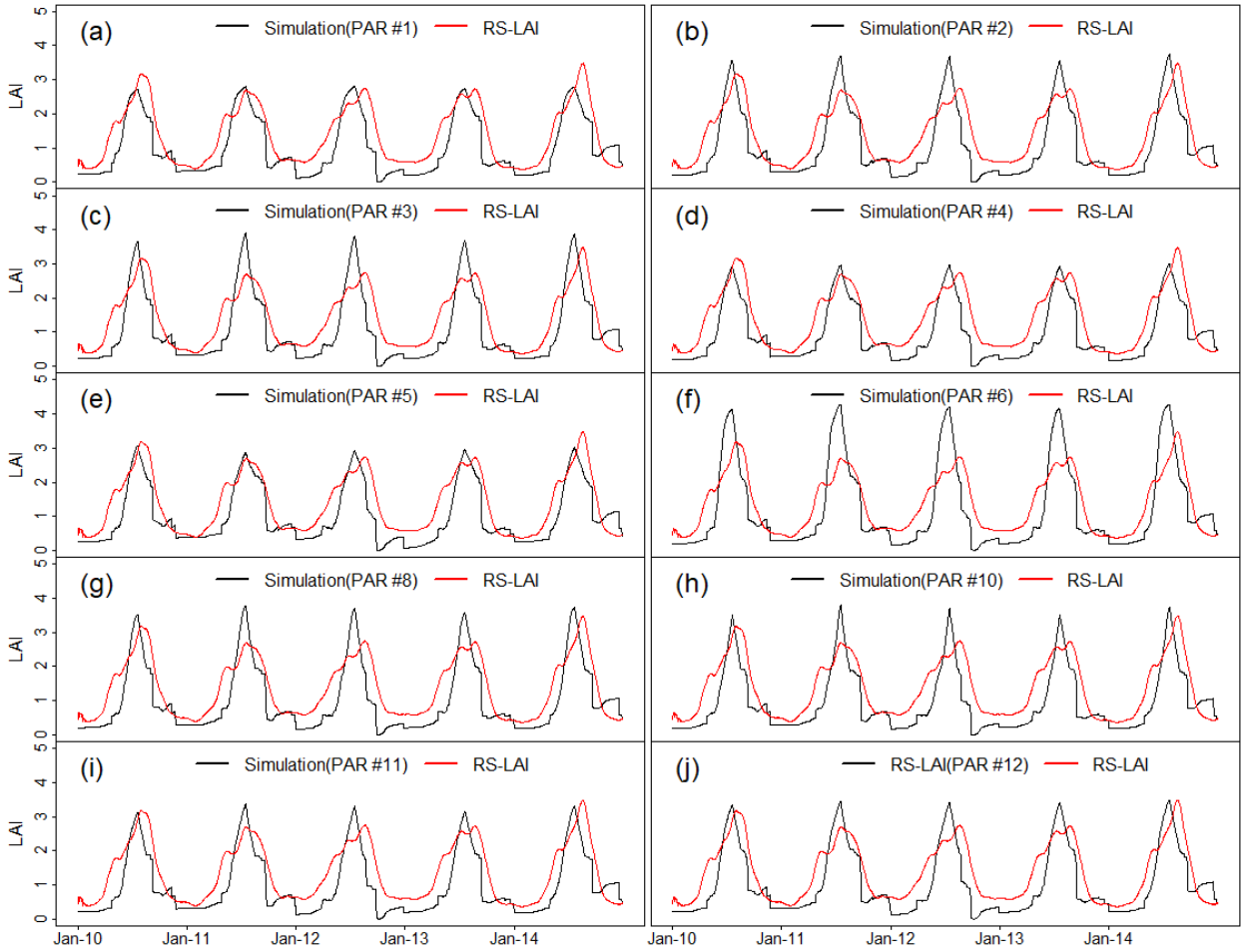

Fig. S3. Comparison of daily simulations with RS-LAI for ten acceptable parameter sets. Simulations from PAR #7 and #9 are shown in Fig. 2 of the main manuscript.