Supplementary material for

1. Integrating Climate Forecasts with the Soil and Water Assessment Tool (SWAT) for High-Resolution Hydrologic Simulations and Forecasts in the Southeastern U.S.

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S1. Climatology (average annual precipitation, and maximum and minimum annual temperatures) of 50 watersheds based on 1979–2013 data

Basin	Watershed	PREC (mm)	Tmin (°C)	Tmax (°C)
0301	30101	96.4	-14.0	37.9
	30102	100.2	-12.2	38.7
	30103	108.0	-10.4	38.1
0302	30201	113.1	-10.0	38.7
	30202	120.3	-9.3	38.3
0303	30301	111.4	-10.0	38.9
	30302	121.5	-9.6	39.6
	30303	131.5	-8.5	39.4
0304	30401	105.7	-10.9	38.7
	30402	122.1	-8.3	39.4
	30403	119.8	-7.9	40.1
0305	30501	109.0	-11.0	38.2
	30502	121.8	-6.0	40.1
	30503	108.2	-9.0	39.3
0306	30601	111.6	-8.7	39.2
	30602	116.6	-6.0	40.1
	30603	112.6	-6.8	40.3
	30604	123.9	-5.5	40.0
0307	30701	113.9	-8.1	39.8
	30702	115.8	-7.6	39.7
	30703	121.7	-6.0	40.0
	30704	131.3	-4.7	39.8
0308	30801	150.8	-0.5	37.8
	30802	144.4	-2.3	38.4
0309	30901	159.7	0.6	38.4
	30902	167.8	2.3	36.5

Basin	Watershed	PREC (mm)	Tmin (°C)	Tmax (°C)
0310	31001	153.7	-0.7	39.3
	31002	141.1	0.4	37.1
	31003	144.0	-2.2	38.8
0311	31101	145.3	-4.1	39.5
	31102	132.0	-5.2	39.6
0312	31201	142.1	-7.1	39.0
0313	31301	122.5	-9.1	38.3
	31302	120.5	-7.4	39.5
	31303	130.4	-4.9	39.2
0314	31401	137.8	-4.9	37.8
	31402	132.3	-5.8	40.0
	31403	133.3	-7.1	39.8
0315	31501	121.6	-11.3	37.8
	31502	124.0	-9.6	38.6
	31503	129.0	-7.9	39.9
0316	31601	130.3	-9.7	39.7
	31602	128.9	-10.1	39.1
	31603	135.2	-7.3	40.0
0317	31701	134.6	-7.8	40.4
	31702	134.8	-7.4	40.5
	31703	143.2	-6.0	39.8
0318	31801	135.1	-8.9	39.9
	31802	135.6	-7.7	40.0
	31803	137.4	-6.5	40.2

S2. Flow hydrographs: SWAT simulation versus USGS observed discharge

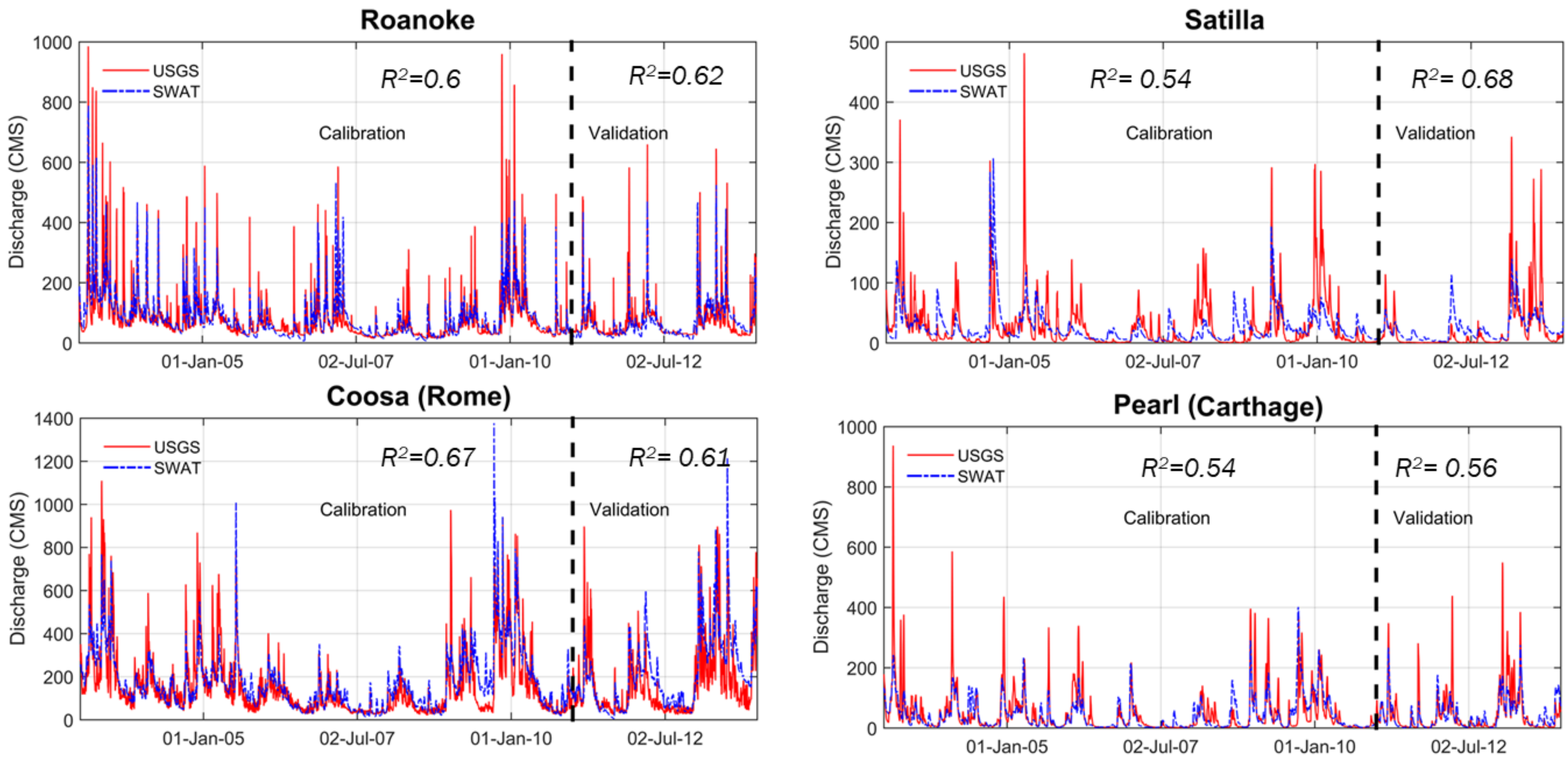
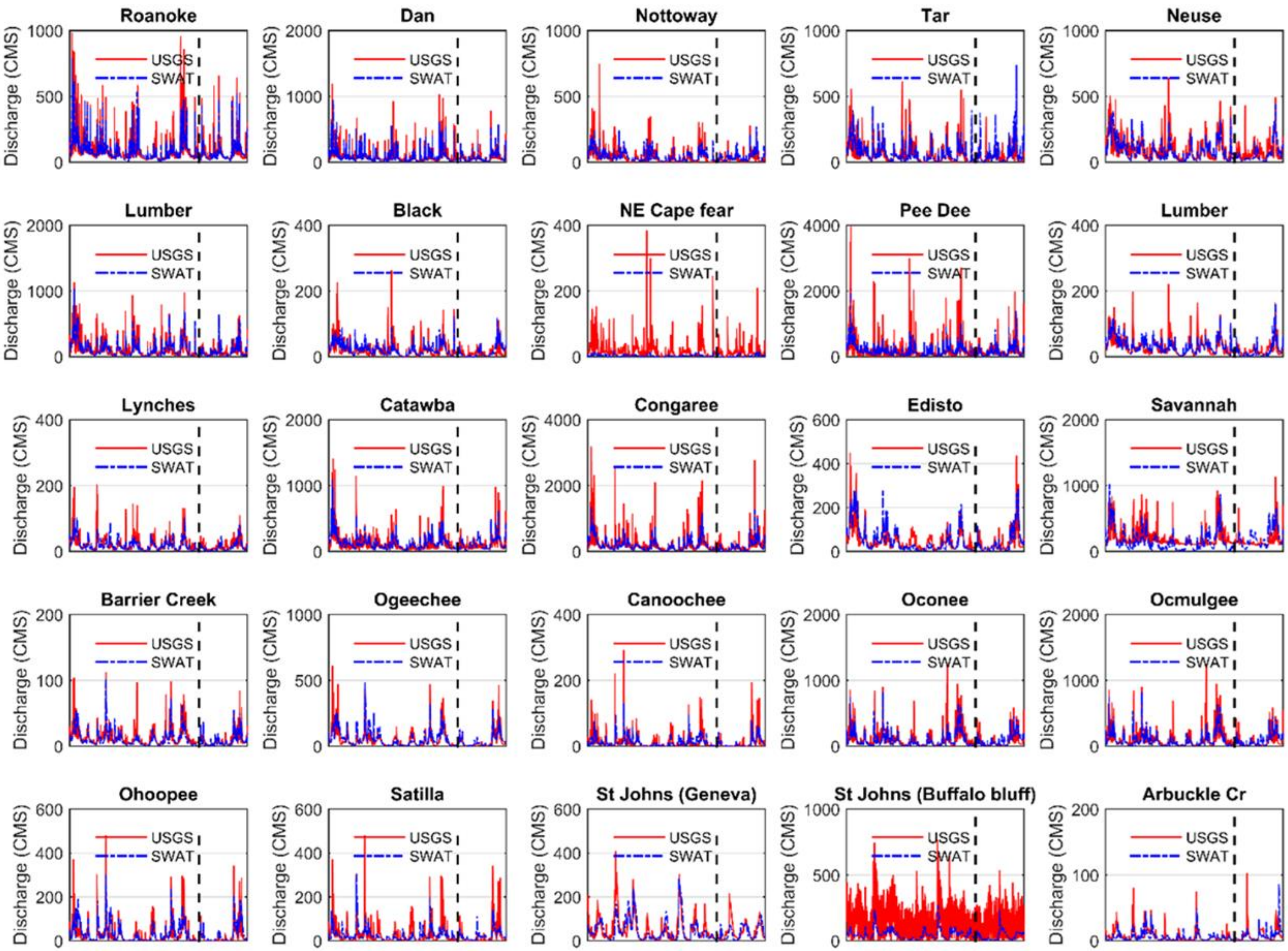
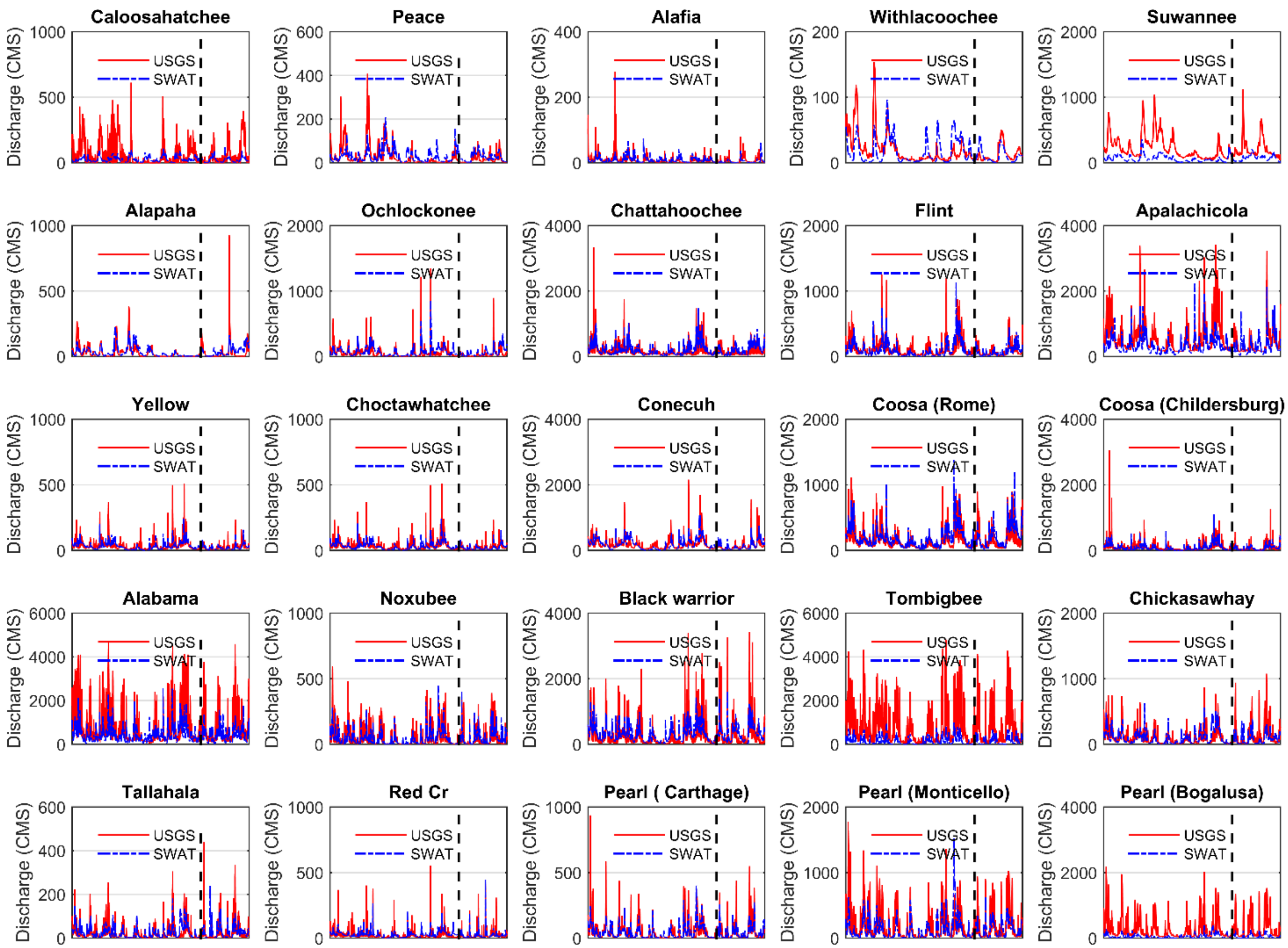


Figure S2-1. Observed vs daily discharge time series at the outlet of four selected watersheds. The dotted black line in the plots demarcates the calibration period (Jan. 2003–Dec. 2010) from the validation period (Jan. 2011–Dec. 2013). Similar plots for the rest of the watersheds can be found below.



Roanoke
Dan
Nottoway
Tar
Neuse
Lumber
Black
NE Cape fear
Pee Dee
Lumber
Lynches
Catawba
Congaree
Edisto
Savannah
Barrier Creek
Ogeechee
Canoochee
Oconee
Ocmulgee
Ohoopee
Satilla
St Johns (Geneva)
St Johns (Buffalo bluff)
Arbuckle Cr
USGS
SWAT
Discharge (CMS)


Caloosahatchee
Peace
Alafia
Withlacoochee
Suwannee
Alapaha
Ochlockonee
Chattahoochee
Flint
Apalachicola
Yellow
Choctawhatchee
Conecuh
Coosa (Rome)
Coosa (Childersburg)
Alabama
Noxubee
Black warrior
Tombigbee
Chickasawhay
Tallahala
Red Cr
Pearl (Carthage)
Pearl (Monticello)
Pearl (Bogalusa)
Discharge (CMS)
USGS
SWAT

S3. Performance statistics of SWAT model calibration and validation for 50 watersheds.

Basin	Lon	Lat	USGS stations	Calibration (2000 to 2010)			Validation (2011 to 2013)		
				Rsq	NRMSE	WI	Rsq	NRMSE	WI
0301	-78.74	36.92	02066000	0.60	0.06	0.52	0.62	0.07	0.54
	-79.09	36.64	02075500	0.48	0.06	0.45	0.50	0.07	0.37
	-77.17	36.77	02047000	0.49	0.06	0.46	0.45	0.12	0.10
0302	-77.37	35.62	02084000	0.52	0.10	0.56	0.35	0.24	0.11
	-77.30	35.31	02091814	0.59	0.10	0.70	0.49	0.12	0.57
0303	-78.96	34.44	02134500	0.64	0.08	0.65	0.53	0.10	0.47
	-78.29	34.76	02106500	0.40	0.07	0.45	0.34	0.14	0.18
	-77.83	34.83	02108000	0.37	0.09	0.37	0.34	0.11	0.39
0304	-79.87	34.95	02129000	0.52	0.05	0.46	0.49	0.07	0.56
	-78.96	34.44	02134500	0.51	0.09	0.62	0.65	0.09	0.59
	-79.75	34.05	02132000	0.41	0.09	0.52	0.51	0.10	0.62
0305	-80.88	34.84	02147020	0.56	0.05	0.56	0.56	0.07	0.48
	-81.05	33.99	02169500	0.51	0.05	0.51	0.58	0.05	0.59
	-80.39	33.03	02175000	0.68	0.07	0.67	0.73	0.07	0.68
0306	-81.94	33.37	02197000	0.46	0.15	0.57	0.18	0.13	-0.08
	-81.65	32.93	02198000	0.53	0.08	0.62	0.73	0.06	0.73
	-81.42	32.19	02202500	0.57	0.08	0.55	0.81	0.06	0.72
	-81.89	32.18	02203000	0.46	0.05	0.43	0.64	0.07	0.46
0307	-82.89	32.54	02223500	0.59	0.07	0.63	0.50	0.13	0.40
	-83.46	32.28	02215000	0.59	0.07	0.63	0.50	0.13	0.40
	-82.18	32.08	02225500	0.54	0.07	0.50	0.68	0.07	0.52
	-81.87	31.22	02228000	0.27	0.08	0.32	0.48	0.09	0.28
0308	-81.04	28.71	02234000	0.63	0.09	0.68	0.43	0.14	0.63
	-81.68	29.60	02244040	0.41	0.20	0.51	0.03	0.24	0.46
0309	-81.30	27.44	02270500	0.41	0.09	0.50	0.18	0.11	0.31
	-81.70	26.72	02292900	0.19	0.14	0.40	0.29	0.19	0.42
0310	-81.88	27.22	02296750	0.33	0.09	0.26	0.48	0.19	0.12
	-82.21	27.87	02301500	0.18	0.04	0.23	0.16	0.12	0.38
	-82.35	28.99	02313000	0.27	0.15	0.42	0.45	0.18	0.58
0311	-82.94	29.59	02323500	0.29	0.20	0.49	0.05	0.17	0.43
	-83.03	30.70	02317500	0.44	0.05	0.31	0.31	0.06	0.09
0312	-84.67	30.18	02330150	0.42	0.06	0.30	0.22	0.08	-0.02
0313	-84.90	33.48	02338000	0.56	0.04	0.52	0.40	0.20	0.10
	-84.02	31.73	02350512	0.51	0.08	0.57	0.53	0.10	0.57
	-85.03	30.43	02358700	0.39	0.13	0.54	0.38	0.09	0.45
0314	-86.92	30.57	02369600	0.43	0.06	0.45	0.35	0.09	0.44
	-85.90	30.45	02366500	0.43	0.06	0.45	0.35	0.09	0.44
	-87.06	31.07	02374250	0.39	0.07	0.45	0.47	0.08	0.46
0315	-85.26	34.20	02397000	0.67	0.08	0.64	0.61	0.13	0.54
	-86.36	33.29	02407000	0.41	0.03	0.47	0.39	0.06	0.44
	-87.55	31.62	02428400	0.48	0.16	0.52	0.33	0.15	0.50
0316	-88.30	32.92	02448500	0.57	0.08	0.53	0.51	0.13	0.40
	-87.84	32.78	02466030	0.54	0.07	0.45	0.50	0.09	0.30
	-88.13	31.76	02469761	0.52	0.21	0.49	0.38	0.23	0.48
0317	-88.55	31.15	02478500	0.45	0.11	0.50	0.29	0.14	0.40
	-89.11	31.33	02474500	0.45	0.08	0.35	0.28	0.09	0.25
	-88.78	30.74	02479300	0.38	0.05	0.16	0.61	0.06	0.35
0318	-89.53	32.71	02482550	0.54	0.05	0.54	0.56	0.09	0.56
	-90.09	31.55	02488500	0.37	0.11	0.51	0.59	0.18	0.56
	-89.82	30.79	02489500	0.42	0.17	0.46	0.67	0.27	0.48

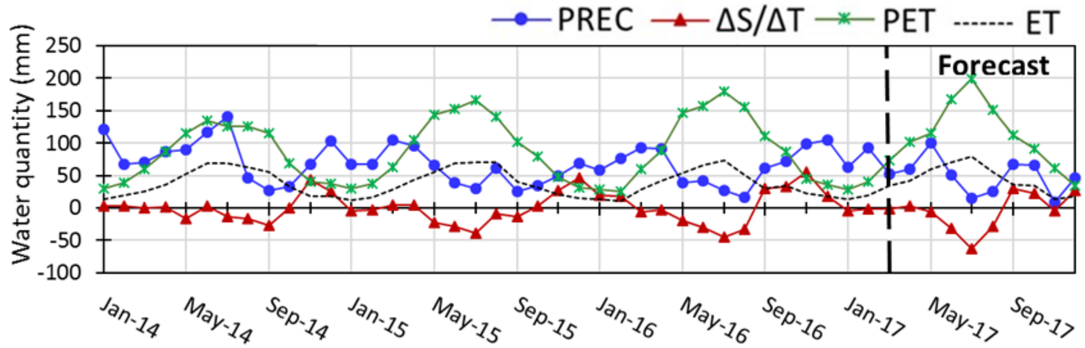
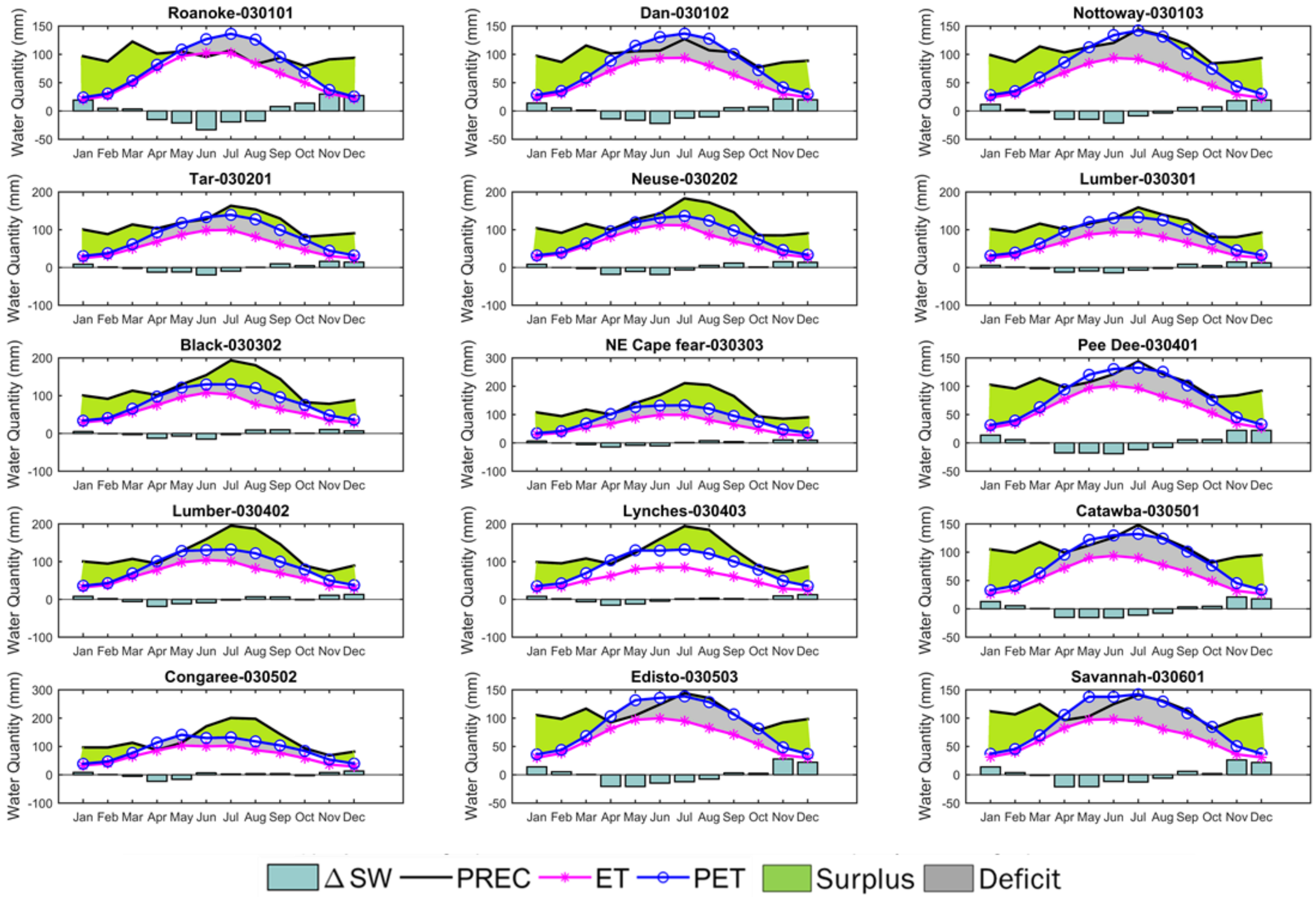
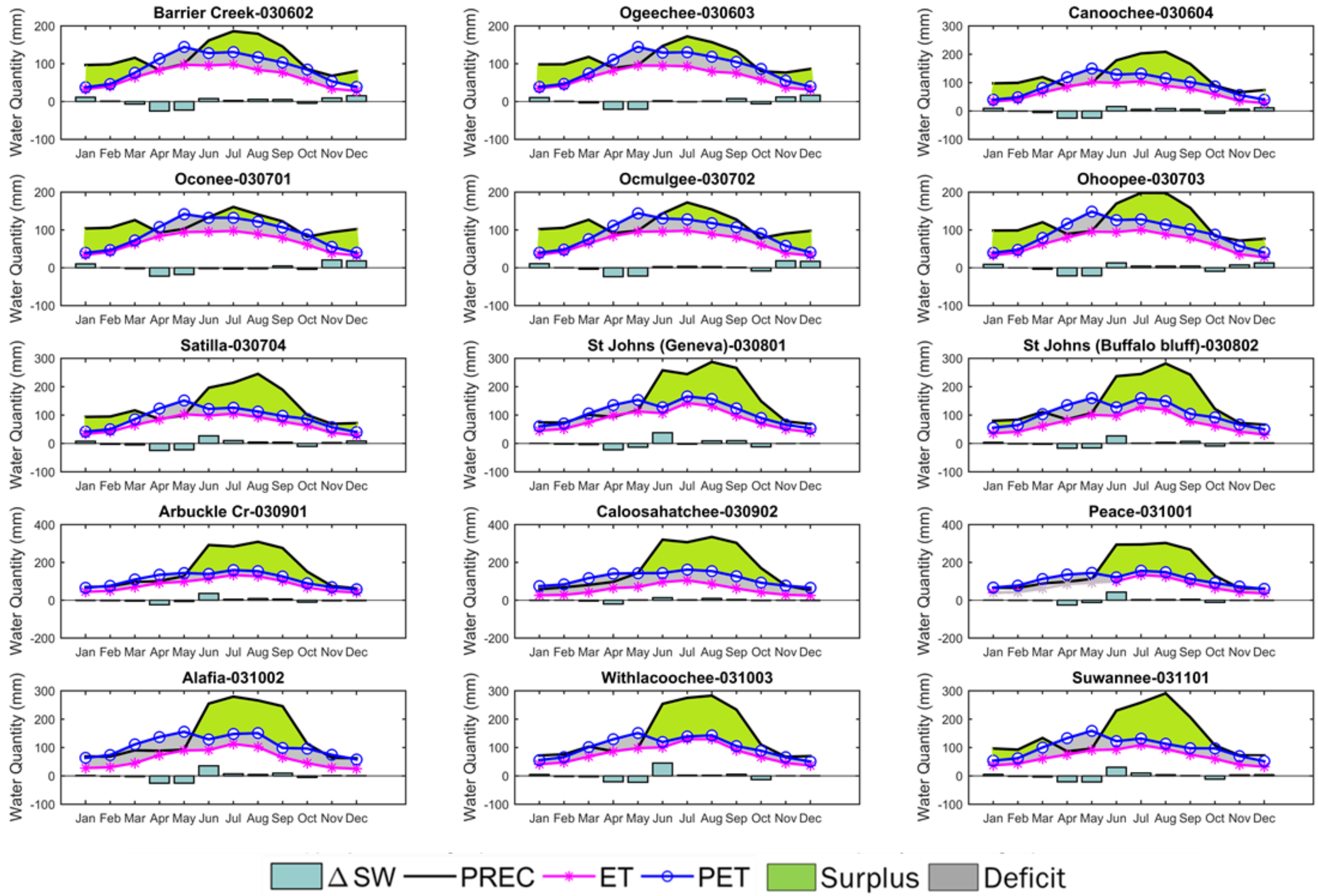


Figure S3-1. Area averaged values of mean monthly precipitation (PREC), actual evaporation (ET), potential evapotranspiration (PET), and change in soil water storage ($\Delta S/\Delta T$) for the study area.

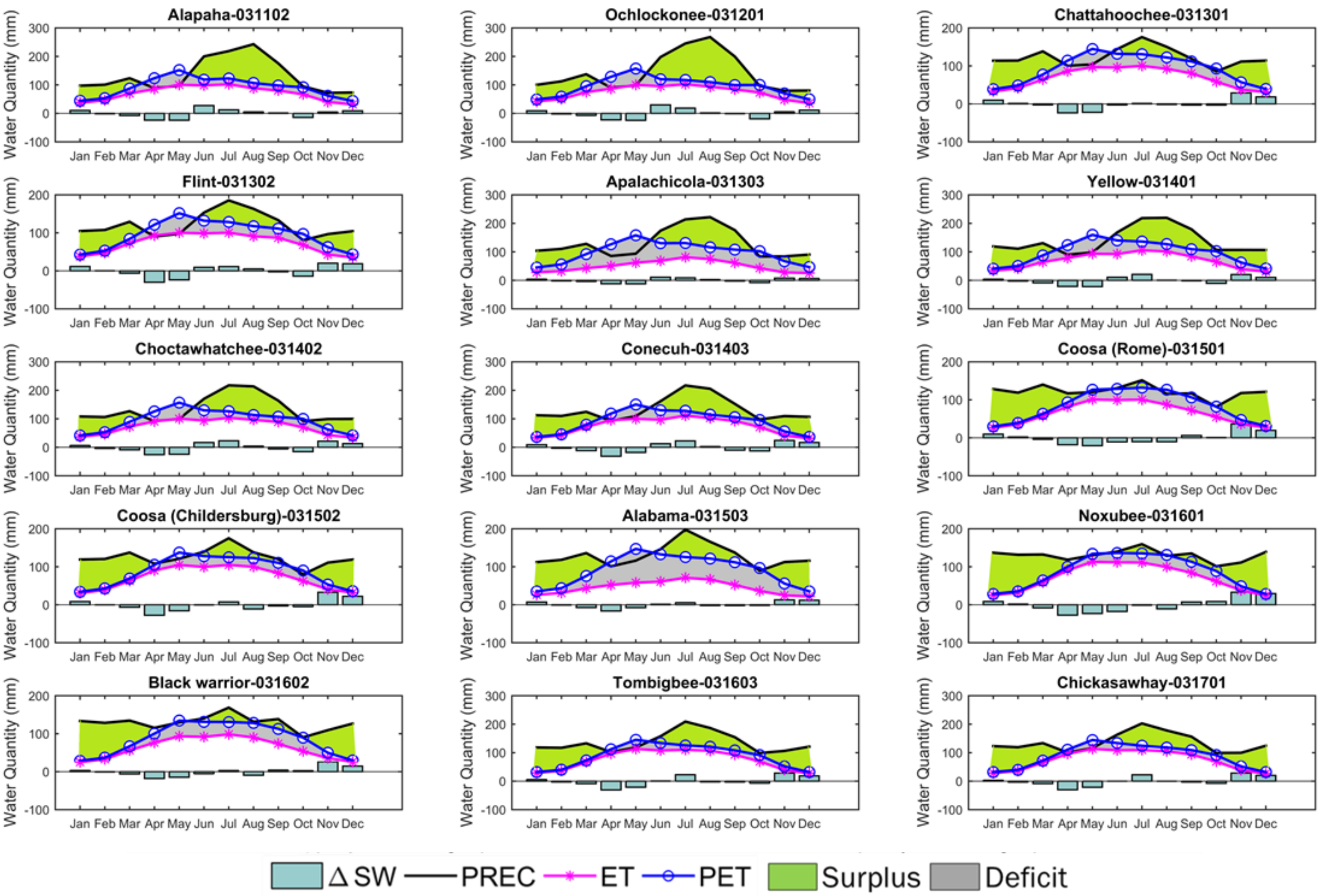
S4. Watershed-scale water balance plots from simulated hydrologic variables using a calibrated SWAT model implementation for the period Jan. 1982–Dec. 2013.



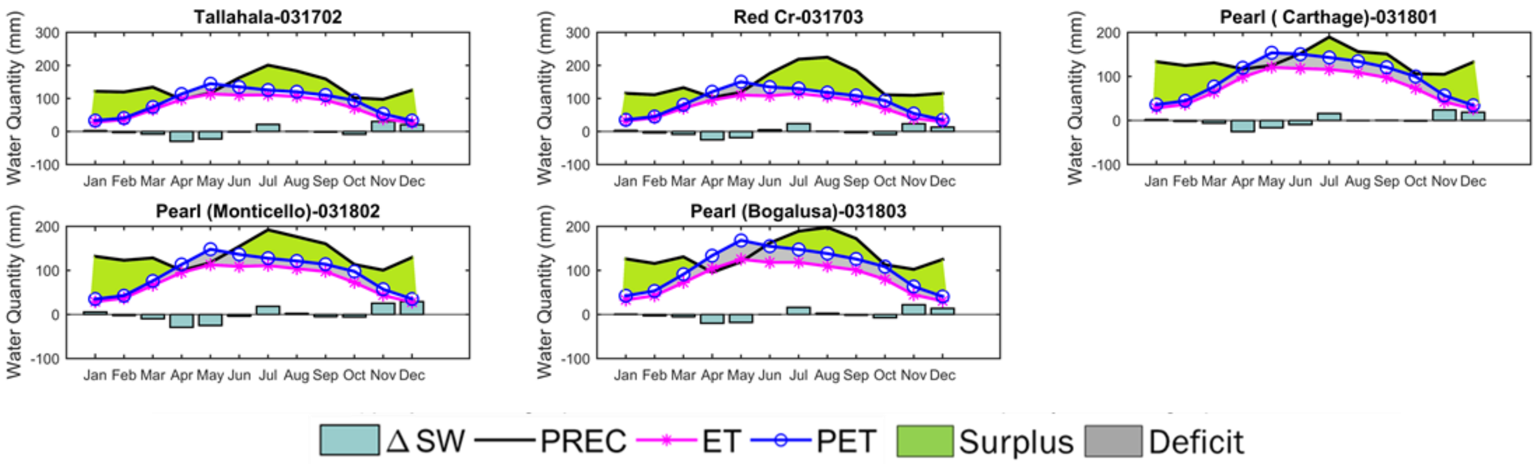
(Contd.) Watershed-scale water balance plots from simulated hydrologic variables using a calibrated SWAT model implementation for the period Jan. 1982–Dec. 2013.



(Contd.) Watershed-scale water balance plots from simulated hydrologic variables using a calibrated SWAT model implementation for the period Jan. 1982–Dec. 2013.



(Contd.) Watershed-scale water balance plots from simulated hydrologic variables using a calibrated SWAT model implementation for the period Jan. 1982–Dec. 2013.



S5. Time series of the soil moisture from an in situ station

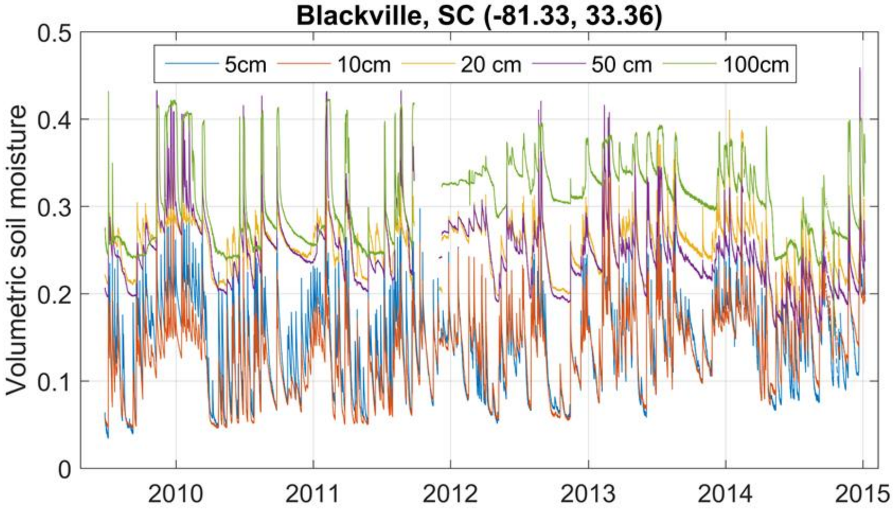


Figure S5-1. Time series of the soil moisture from five sensors at 5 cm, 10 cm, 20 cm, 50 cm, and 100 cm depths from an observation station in Blackville, South Carolina.

S6. Modeling evapotranspiration

ET can display significant spatial variability based on vegetation (canopy, vegetation type), topography, local environmental conditions, water supply, etc. [1-3]. Hence, an analysis was carried out to highlight this variability in ET and PET estimates from the SWAT model based on land use. Figure S6-1 provides a comparison of the actual ET and PET values (annual sum) averaged over land use type as defined by the National Land Cover Dataset, 2001. There was clear distinction in the PET and ET values for the different land use types. While energy and water-rich areas have a higher PET, ET was seen to be the highest over water bodies and wetlands due to the abundance of water and less resistance for evaporation, closely followed by barren land, shrubs, and grasslands. ET and PET follow a complementary relationship due to the land–atmosphere feedback mechanism, which is well studied in the literature [4,5], where PET decreases with the available moisture in the near-surface boundary layer due to increases in actual ET as first proposed by Bouchet [6]. The complementary relationship between the SWAT-simulated ET and PET values (annual total) for various land use types is shown in Figure S6-2. The effect of land use is evident from Figure S6-2. While most land use types show good agreement with the complementary relationship, wetlands and cultivated land types show relatively less agreement with the complementary relationship between PET and ET. Due to saturated soil conditions, ET tends to have low variability over the seasons, and hence the convergence of PET and ET does not take place. Similarly, the effect of anthropogenic activities can be seen on PET and ET partitioning in areas where land cover is subjected to changes, while forested areas reveal a better convergence of PET and ET.

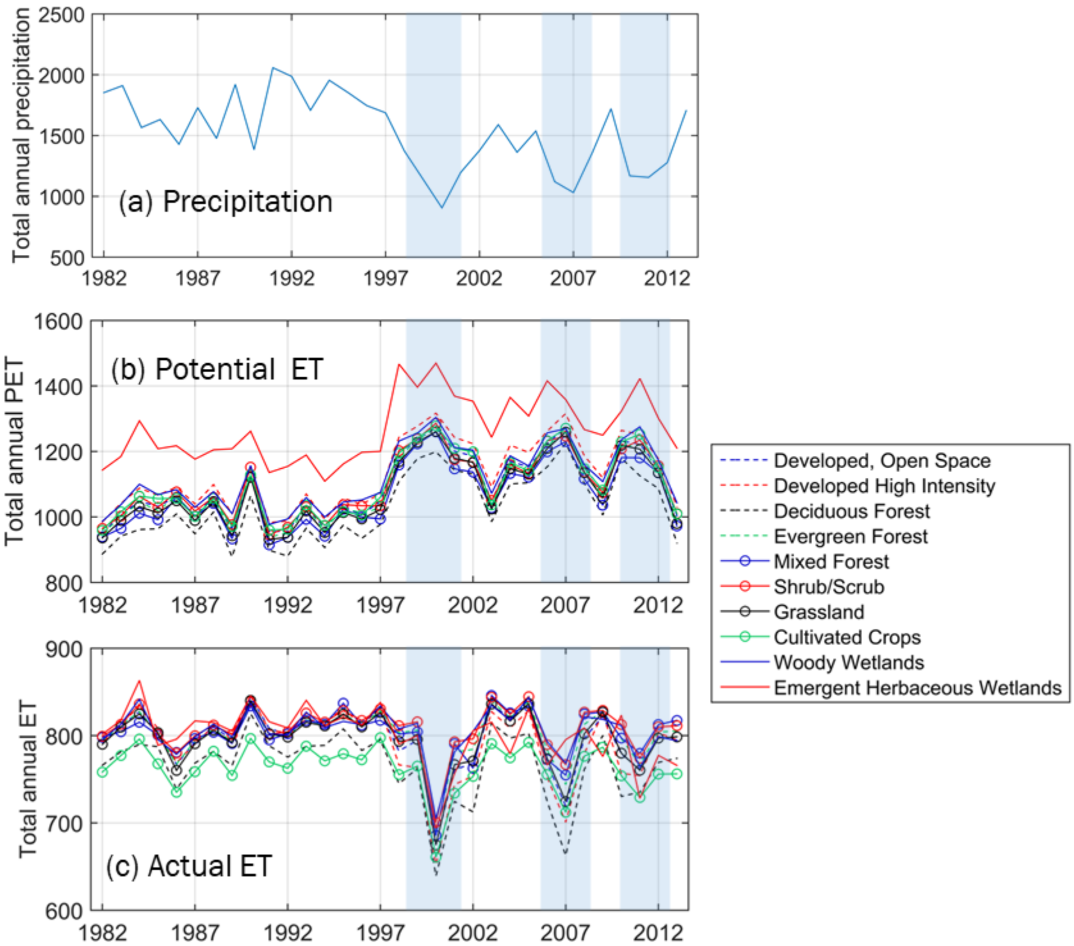
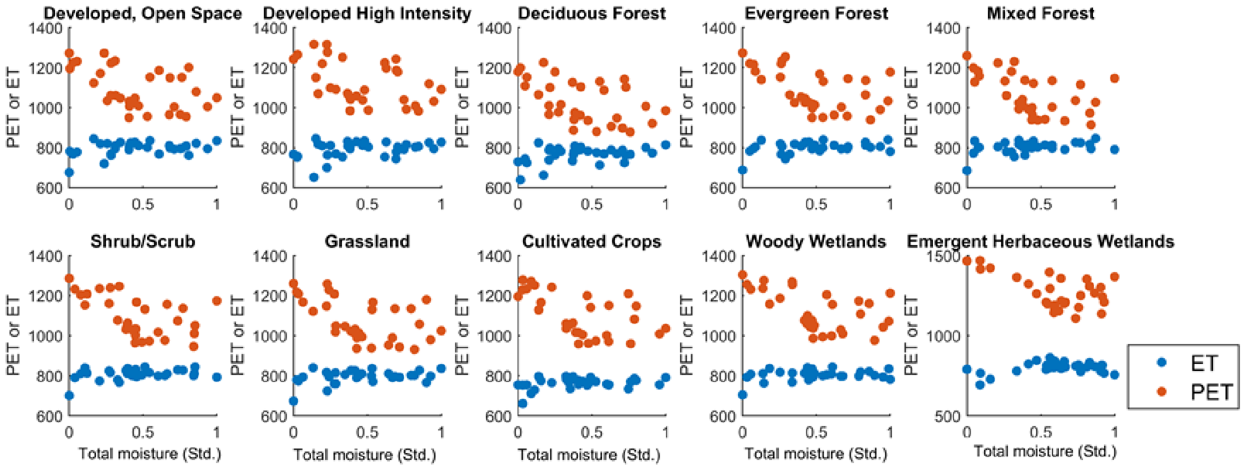
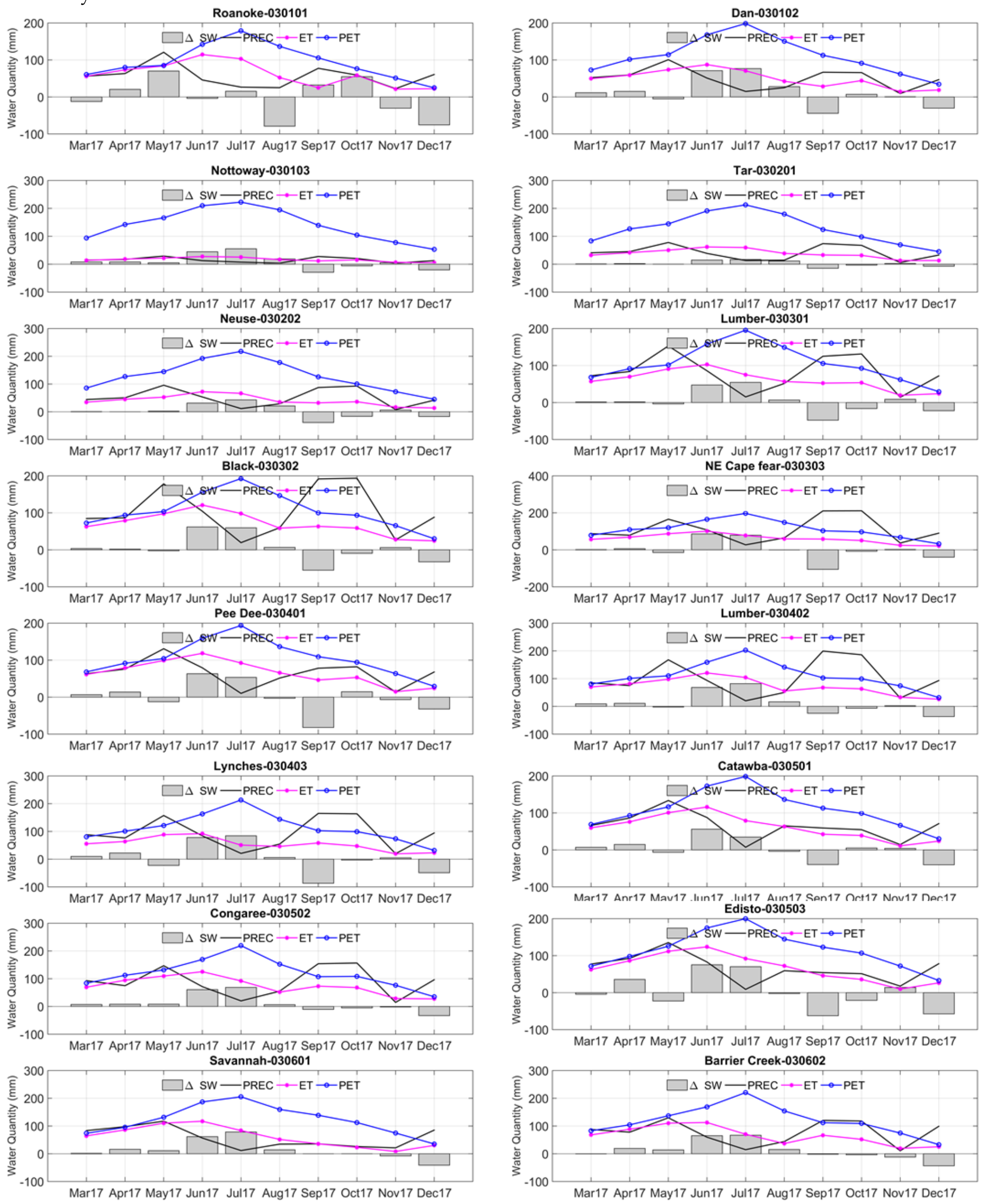


Figure S6-1. Area averaged total annual values for (**a**) precipitation (**b**) potential ET (PET) and (**c**) actual ET based on land-use type. Light blue shade indicates severe drought years.

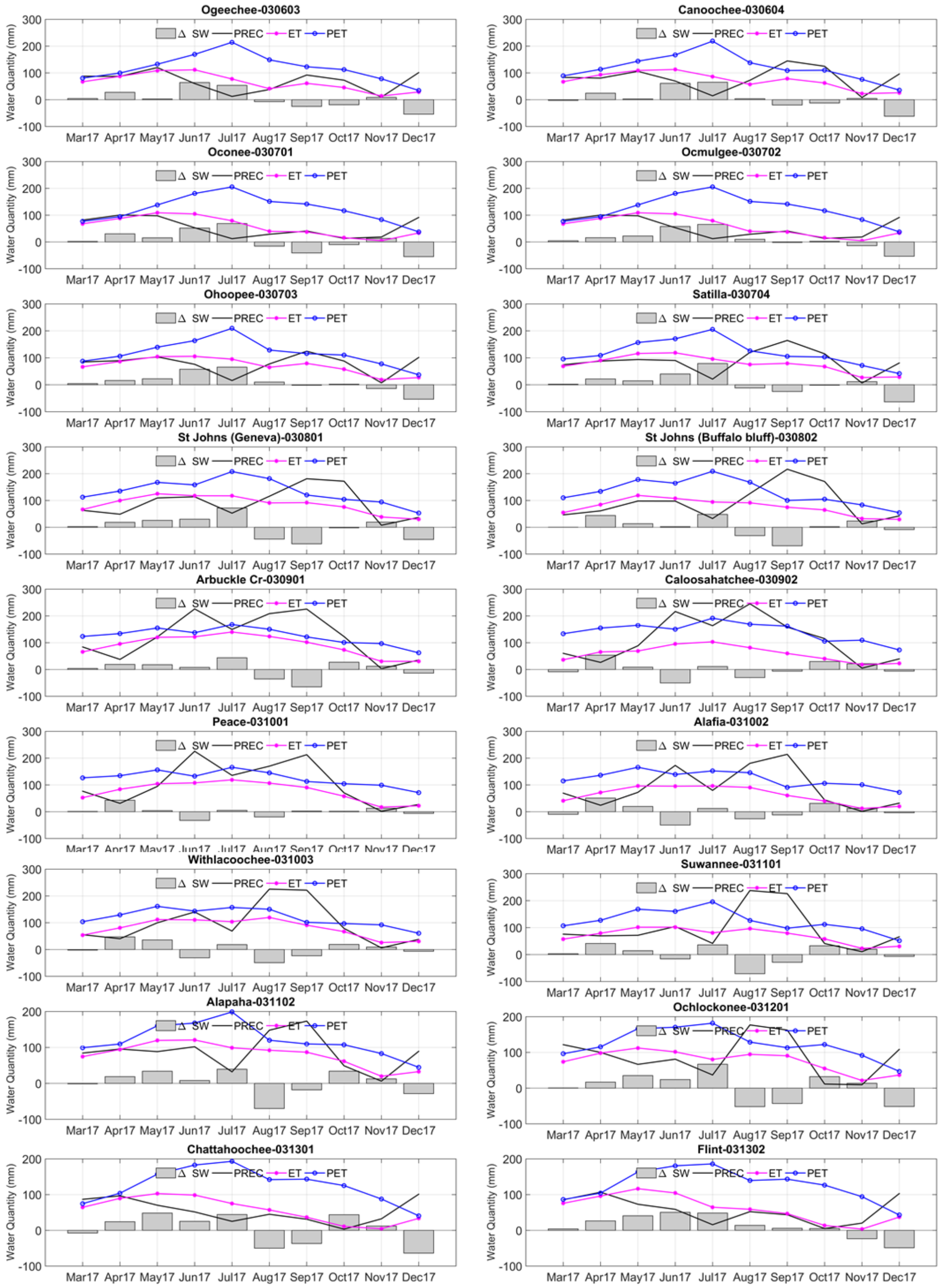


FigureS6-2. Complementary relationship between actual ET and PET based on the total annual values for various land-use classes.

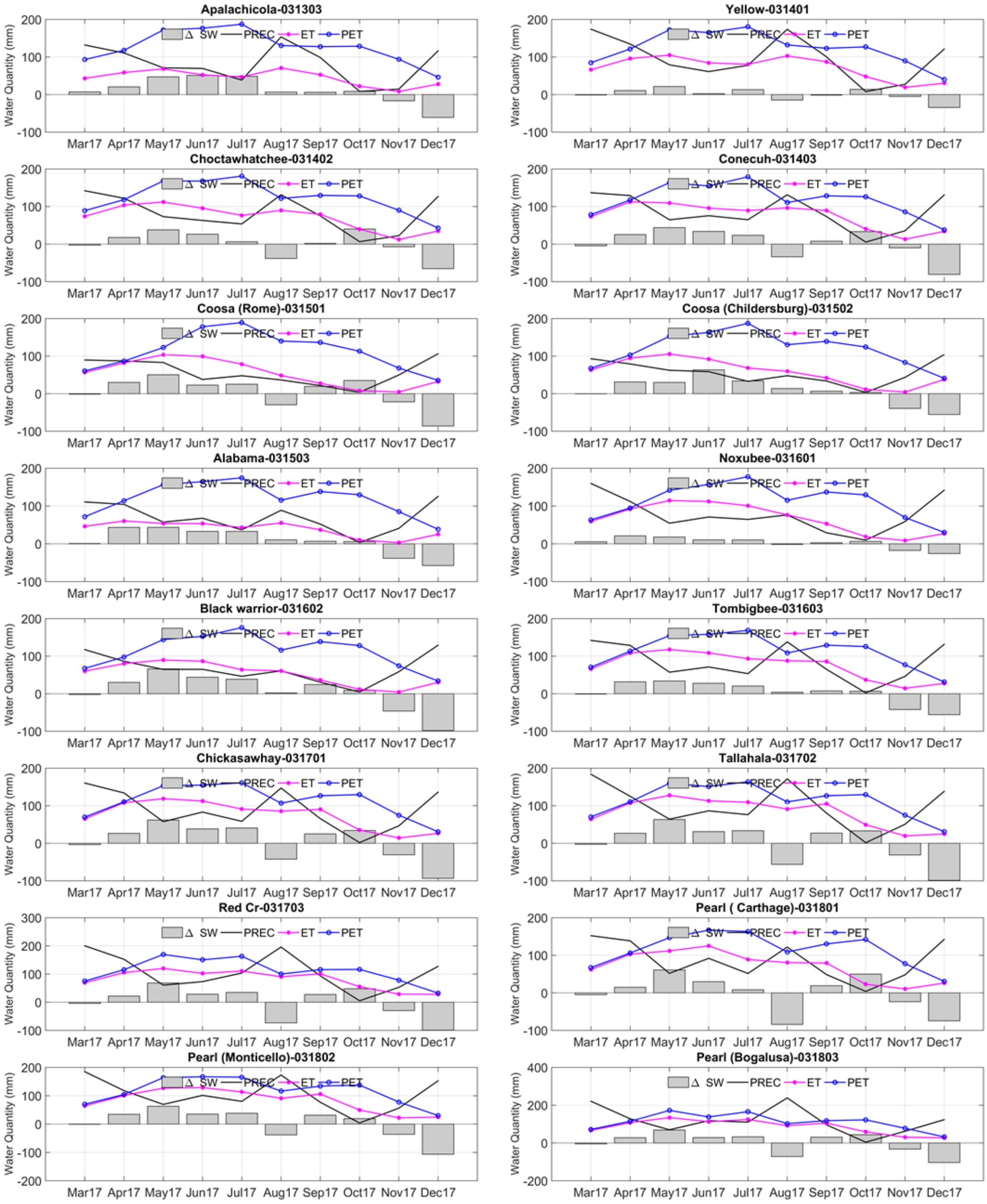
S7. Watershed-scale time series of the forecasted hydrologic variables (precipitation, actual evapotranspiration, potential evapotranspiration, and soil moisture) simulated using SWAT-CFSv2 hybrid models.



(Contd.) Watershed-scale time series of the forecasted hydrologic variables (precipitation, actual evapotranspiration, potential evapotranspiration, and soil moisture) simulated using SWAT-CFSv2 hybrid models.



(Contd.) Watershed-scale time series of the forecasted hydrologic variables (precipitation, actual evapotranspiration, potential evapotranspiration, and soil moisture) simulated using SWAT-CFSv2 hybrid models.



S8. Observed precipitation for the forecast period

Observed total precipitation (in mm) is provided below for the forecast period (April–December 2017) for comparison with the SWAT-CFSv2 model forecasts as provided in Figure 12 of the manuscript.

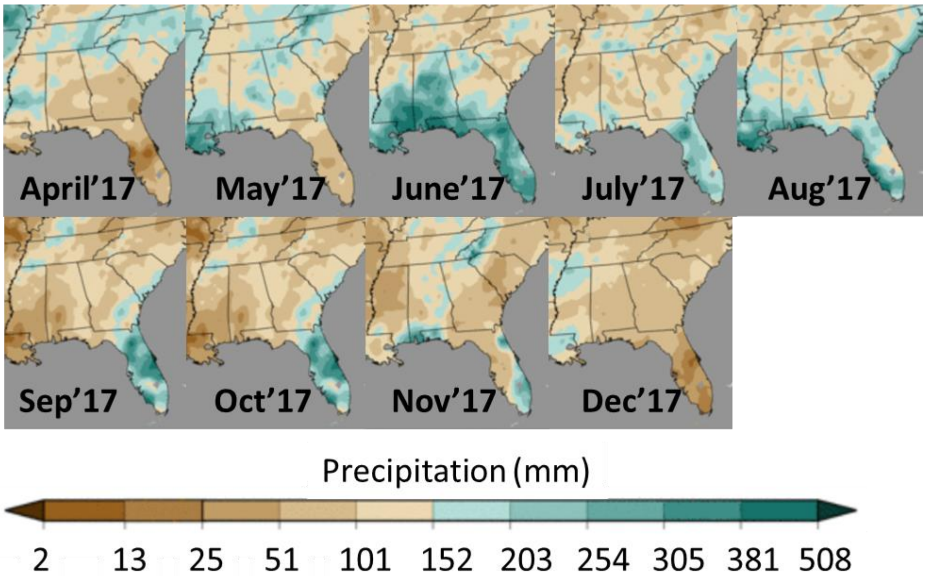


Figure S8.1. Observed precipitation for the study region as provided by the National Oceanic and Atmospheric Administration (NOAA)

References:

1. Liu, W.; Hong, Y.; Khan, S.I.; Huang, M.; Vieux, B.; Caliskan, S.; Grout, T. Actual evapotranspiration estimation for different land use and land cover in urban regions using landsat 5 data. *Journal of Applied Remote Sensing* **2010**, *4*, 041873.
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