A Dynamic Process-Based Method for Screening Salt-Tolerant and High-Yielding Crop Varieties

Supplementary material:

Table Captions

Table.S1. Soil physical properties in maize fields

Table.S2. Experiment on the growth period of maize varieties

Table.S3. Maize irrigation schedule in 2023

Table.S4. Specifies the main parameters of the model

Table.S5. Values of fitness indicators related to model calibration

Table.S6. Standardized values and fitness values

Table S1:

Degree of salinity	Depth （cm）	Clay content （<0.002 mm）	Powder content （0.002-0.02 mm）	Sand content （0.02-2 mm）	Texture	γ_d （g cm^{-3}）
moderate	0-20	16.46%	45.55%	37.99%	Silty loam	1.73
	20-40	14.27%	42.58%	43.15%	Sandy loam	1.60
	40-60	13.90%	45.59%	40.51%	Silty loam	1.64
	60-80	16.52%	52.87%	30.61%	Silty loam	1.59
	80-100	15.94%	47.63%	36.42%	Silty loam	1.63

Note： γ_d is dry volume weight

Table S2:

Degree of salinity	variety	sow	Seedling stage	Jointing stage	Spinning stage	Filling stage	Mature stage
moderate	Xianyu 335	4.27	5.12	6.7	7.22	8.6	9.17
	Yinyu238	4.27	5.12	6.8	8.1	8.16	9.23
	Jindan73	4.27	5.11	6.7	7.28	8.13	9.19
	Deke622	4.27	5.11	6.8	7.28	8.14	9.21
	DK-815	4.27	5.12	6.8	7.27	8.12	9.17
	Heyu157	4.27	5.12	6.8	7.26	8.12	9.21
	Xianyu1321	4.27	5.11	6.7	7.21	8.6	9.18
	Jinrun919	4.27	5.11	6.7	7.21	8.6	9.19
	Tianci19	4.27	5.11	6.7	7.22	8.7	9.18
	Xianyu1225	4.27	5.11	6.7	7.19	8.5	9.17

Table S3:

Table S3 Maize irrigation in growth stages of 2023

Date (Month/Day)	5/14	6/5	6/20	7/4	7/15	7/25	8/4	8/14	8/24	9/7	total
Irrigation volume (m^3/ mu)	15	30	30	25	25	25	25	25	20	20	240

Table S4:

parameters	definition	Jindan 73	Deke 622	Jinrun 919	Xianyu 1321	Xianyu 335	Yinyu 238	DK-815	Heyu 157	Tianci 19	Xianyu 1225
c	Extinction coefficient	0.85	0.85	0.7	0.7	0.85	0.85	0.85	0.85	0.85	0.85
TSDTT	The cumulative effective accumulated temperature of maize from emergence to silking（℃）	1063	1063	953	967	960	1112	1041	1027	967	923
PHU	The maximum heat unit required for crop ripening（℃）	2100	2100	2100	2100	2000	2000	2000	2100	2100	2100
r^s_{smin}	The soil surface reaches the minimum surface resistance at field holding（s m^{-1}）	750	750	500	500	750	750	750	750	750	750
H_{cmax}	Maximum corn plant height（cm）	280	260	280	263	280	270	290	290	290	298
$x_1 \cdot y_1$	—	0.05	0.04	0.045	0.05	0.05	0.05	0.05	0.05	0.05	0.05
x_2	—	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
x_3	—	0.075									
y_2	—	2.8	2.8	2.6	2.8	2.8	2.8	2.8	2.8	2.8	2.8
y_3	—	4.5	4.1	4.6	4.5	4.3	4.9	4.1	4.2	4.2	4.5
Q_{10}	Respiratory temperature coefficient（2 kg C m^{-2} d^{-1} 10℃$^{-1}$）	2									
r_{m0}	Maintenance respiratory coefficient at basal temperature（kg C kg^{-1} d^{-1}）	0.032									
r_g	Growth respiration coefficient	0.28									
T_b	The base temperature of crop growth（℃）	9									

Table S5:

Evaluation object		*b*	R^2	RMSE	NSE	*n*
LAI（$m^3\ m^{-3}$）	Jindan73	1.02	0.98	0.35	0.98	11
	Deke622	0.90	0.98	0.47	0.95	
	Xianyu1321	0.91	0.93	0.77	0.90	
	Jinrun919	0.92	0.93	0.67	0.92	
	Xianyu335	0.93	0.96	0.47	0.94	
	Yinyu238	0.91	0.97	0.72	0.95	
	Xianyu1225	1.00	0.95	0.50	0.95	
	DK-815	0.98	0.91	0.60	0.91	
	Heyu157	0.98	0.98	0.33	0.98	
	Tianci19	0.99	0.96	0.44	0.96	
h_c（m）	Jindan73	1.00	0.95	0.24	0.94	11
	Deke622	0.94	0.98	0.21	0.95	
	Xianyu1321	0.93	0.96	0.26	0.93	
	Jinrun919	0.92	0.96	0.29	0.92	
	Xianyu335	1.03	0.98	0.20	0.96	
	Yinyu238	0.98	0.96	0.23	0.94	
	Xianyu1225	0.93	0.95	0.31	0.92	
	DK-815	1.00	0.96	0.23	0.95	
	Heyu157	1.03	0.95	0.26	0.93	
	Tianci19	0.99	0.95	0.26	0.93	
Soil water content ($cm^3\ cm^{-3}$)	Jindan73	1.00	0.76	0.02	0.75	12
	Deke622	1.09	0.78	0.03	0.45	
	Xianyu1321	1.04	0.51	0.03	0.36	
	Jinrun919	1.10	0.80	0.03	0.51	
Soil salt concentration ($g\ L^{-1}$)	Jindan73	0.91	0.65	0.68	0.51	16
	Deke622	0.83	0.59	0.73	0.50	
	Xianyu1321	0.96	0.30	0.60	0.25	
	Jinrun919	0.88	0.52	0.77	0.25	
Groundwater depth（m）	Jindan73	0.99	0.60	0.23	0.59	132

Table S6:

	ET	LAI	NEP	g_c	h_c	Fitness value *F*
Xianyu335	0.08	0.59	0.19	0.78	0.47	0.36
	0.07	0.59	0.16	0.70	0.47	0.34
	0.06	0.58	0.14	0.61	0.47	0.31
	0.05	0.57	0.12	0.53	0.47	0.29
	0.04	0.56	0.09	0.44	0.47	0.27
	0.03	0.56	0.07	0.35	0.47	0.25
	0.02	0.55	0.05	0.27	0.47	0.22

	0.01	0.54	0.02	0.18	0.47	0.20
	0.00	0.53	0.00	0.10	0.47	0.18
	0.11	0.80	0.57	0.73	0.00	0.34
	0.10	0.79	0.54	0.62	0.00	0.31
	0.09	0.78	0.50	0.50	0.00	0.28
	0.07	0.77	0.47	0.38	0.00	0.25
Yinyu238	0.06	0.76	0.44	0.27	0.00	0.22
	0.04	0.75	0.40	0.15	0.00	0.19
	0.03	0.74	0.37	0.03	0.00	0.15
	0.03	0.73	0.36	0.00	0.00	0.15
	0.03	0.73	0.36	0.00	0.00	0.15
	0.23	1.00	1.00	1.00	0.49	0.62
	0.22	0.99	0.97	0.92	0.49	0.60
	0.21	0.98	0.95	0.83	0.49	0.58
	0.20	0.98	0.92	0.75	0.49	0.55
Jindan73	0.19	0.97	0.90	0.66	0.49	0.53
	0.18	0.96	0.87	0.58	0.49	0.51
	0.17	0.95	0.85	0.49	0.49	0.49
	0.16	0.94	0.82	0.41	0.49	0.46
	0.15	0.94	0.79	0.33	0.49	0.44
	0.19	0.04	0.30	0.61	0.05	0.23
	0.18	0.03	0.28	0.52	0.05	0.21
	0.17	0.03	0.25	0.44	0.05	0.18
	0.16	0.02	0.23	0.35	0.05	0.16
Deke622	0.15	0.02	0.20	0.27	0.05	0.14
	0.13	0.01	0.18	0.19	0.05	0.12
	0.12	0.01	0.16	0.10	0.05	0.09
	0.11	0.00	0.13	0.02	0.05	0.07
	0.11	0.00	0.13	0.00	0.05	0.07
	0.18	0.78	0.57	0.93	1.00	0.62
	0.17	0.77	0.55	0.86	1.00	0.60
	0.17	0.76	0.53	0.78	1.00	0.58
	0.16	0.76	0.51	0.71	1.00	0.56
DK-815	0.15	0.75	0.49	0.64	1.00	0.54
	0.14	0.74	0.47	0.57	1.00	0.52
	0.13	0.74	0.45	0.49	1.00	0.50
	0.12	0.73	0.43	0.42	1.00	0.48
	0.12	0.72	0.41	0.35	1.00	0.46
	0.17	0.76	0.54	0.80	0.61	0.49
	0.16	0.76	0.51	0.70	0.61	0.47
Heyu157	0.14	0.75	0.48	0.60	0.61	0.44
	0.13	0.74	0.45	0.50	0.61	0.42
	0.12	0.73	0.42	0.40	0.61	0.39
	0.11	0.72	0.39	0.30	0.61	0.36

	0.10	0.71	0.36	0.20	0.61	0.34
	0.08	0.70	0.33	0.10	0.61	0.31
	0.07	0.69	0.31	0.00	0.61	0.28
	0.93	0.45	0.27	0.66	0.03	0.53
	0.92	0.45	0.25	0.59	0.03	0.51
	0.91	0.44	0.23	0.51	0.03	0.49
	0.91	0.43	0.20	0.43	0.03	0.47
Xianyu1321	0.90	0.43	0.18	0.36	0.03	0.45
	0.89	0.42	0.16	0.28	0.03	0.43
	0.88	0.42	0.14	0.20	0.03	0.41
	0.87	0.41	0.12	0.12	0.03	0.39
	0.86	0.40	0.10	0.05	0.03	0.37
	1.00	0.81	0.57	0.74	0.21	0.69
	0.99	0.80	0.55	0.65	0.21	0.67
	0.98	0.79	0.52	0.56	0.21	0.65
	0.97	0.78	0.50	0.48	0.21	0.62
Jinrun919	0.96	0.78	0.47	0.39	0.21	0.60
	0.95	0.77	0.45	0.30	0.21	0.58
	0.94	0.76	0.42	0.21	0.21	0.56
	0.93	0.75	0.39	0.13	0.21	0.53
	0.92	0.74	0.37	0.04	0.21	0.51
	0.12	0.81	0.58	0.78	0.42	0.44
	0.11	0.80	0.55	0.67	0.42	0.42
	0.09	0.79	0.52	0.56	0.42	0.39
	0.08	0.78	0.49	0.45	0.42	0.36
Tianci19	0.07	0.77	0.46	0.35	0.42	0.33
	0.06	0.76	0.43	0.24	0.42	0.30
	0.04	0.75	0.40	0.13	0.42	0.27
	0.03	0.74	0.37	0.03	0.42	0.25
	0.03	0.73	0.36	0.00	0.42	0.24
	0.14	0.82	0.64	0.95	0.59	0.53
	0.13	0.82	0.61	0.88	0.59	0.51
	0.12	0.81	0.59	0.81	0.59	0.49
	0.11	0.80	0.57	0.74	0.59	0.47
Xianyu1225	0.11	0.80	0.55	0.66	0.59	0.45
	0.10	0.79	0.53	0.59	0.59	0.43
	0.09	0.78	0.51	0.52	0.59	0.42
	0.08	0.78	0.49	0.45	0.59	0.40
	0.07	0.77	0.47	0.38	0.59	0.38

Figure Captions

Figure S1. Variations of daily average net photosynthetically active radiation (PAR), air temperature (Ta), ra-diation (Rn), water vapor pressure deficit (VPD), frictional wind speed (u*) and horizontal wind speed (u) of maize.

Figure S2. Variations of irrigationnt (I) and rainfall (P) during maize growth period.

Figure S3. Variations of groundwater depth during maize growth period.

Figure S4. Comparison of simulated and measured leaf area index of maize.

Figure S5. Comparison of simulated and measured plant height of maize.

Figure S6. Comparison between simulated results and measured values of soil water content in different depth layers during maize growth period.

Figure S7. Comparison of simulated results and measured values of soil electrical conductivity in root zone during maize growth period.

Figure S8. Simulation results of groundwater depth in maize growth period and comparison with measured values.

Figure S1

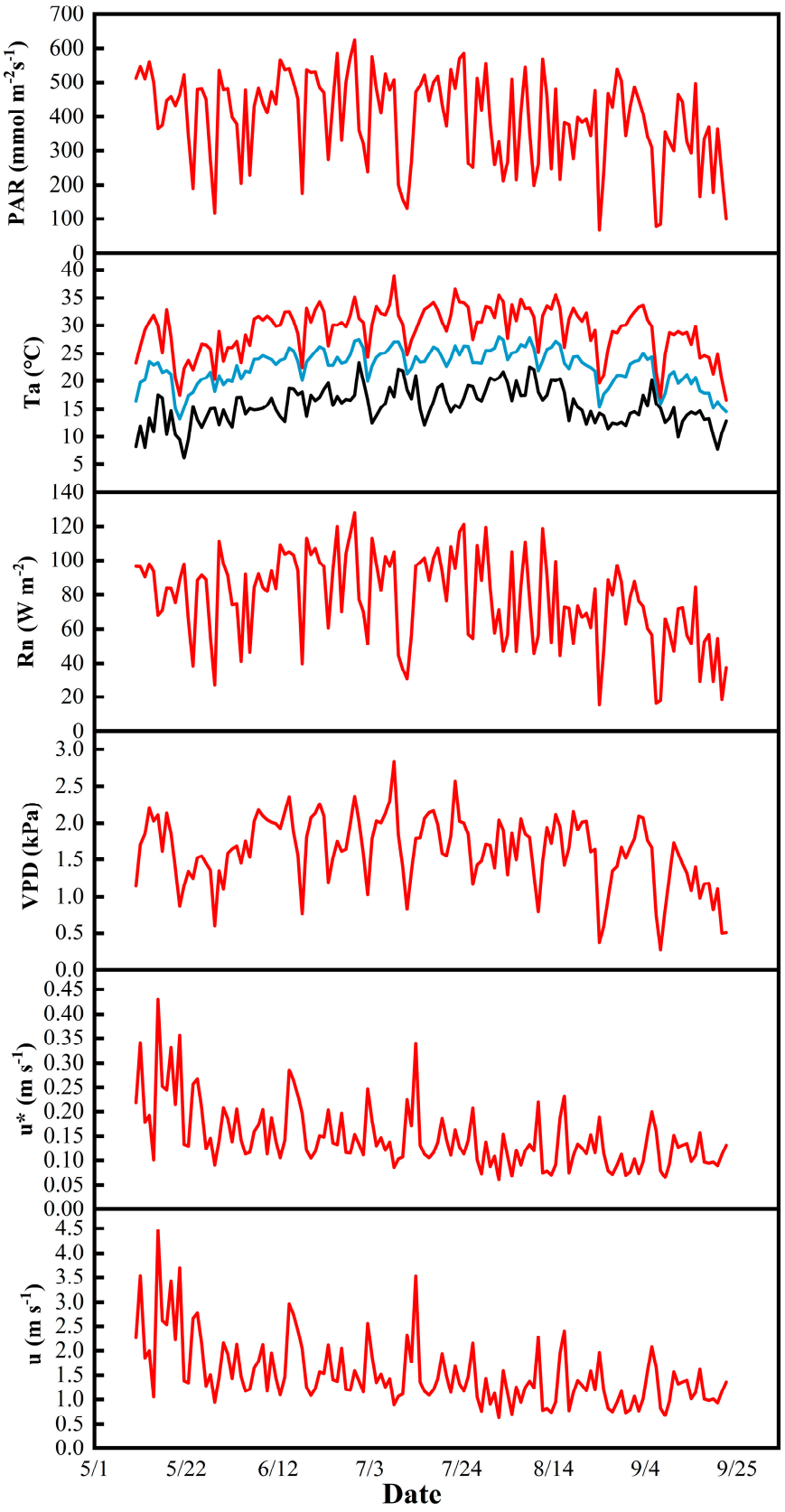

PAR (mmol m-2s-1)
Ta (°C)
Rn (W m-2)
VPD (kPa)
u* (m s-1)
u (m s-1)
5/1
5/22
6/12
7/3
7/24
8/14
9/4
9/25
Date

Figure S2

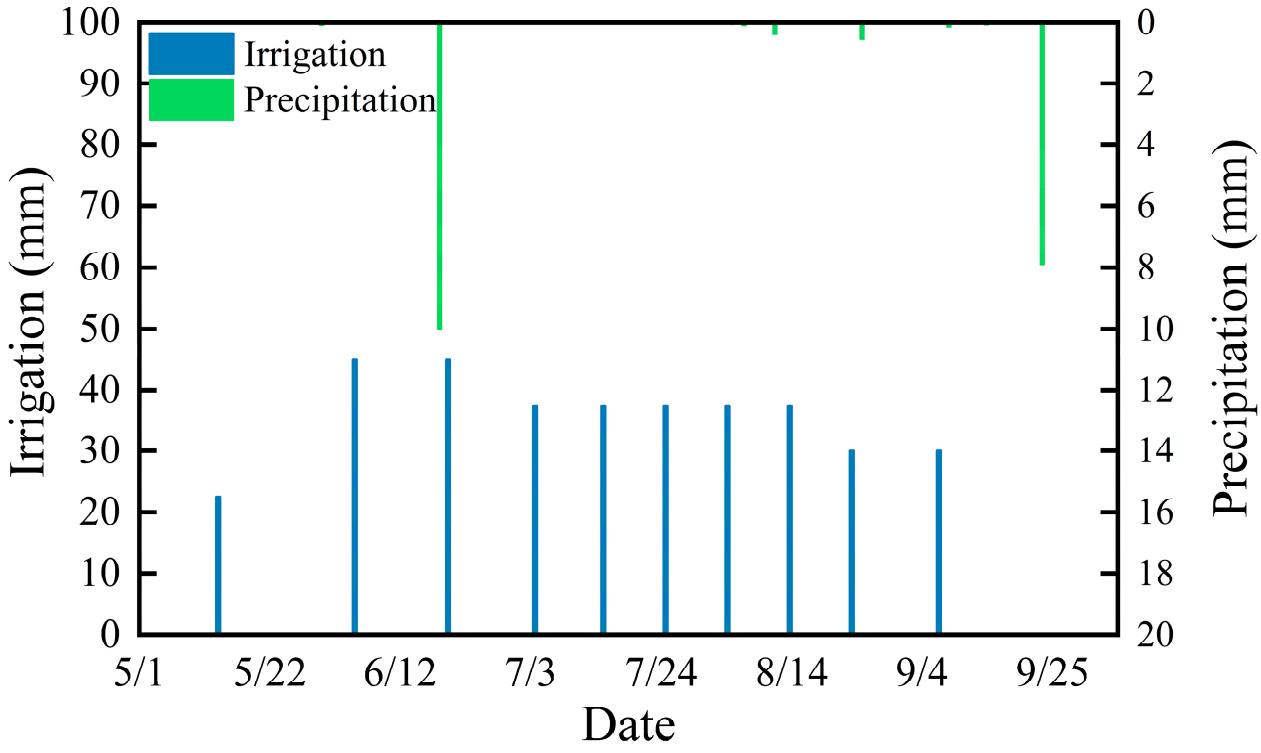


Figure S3

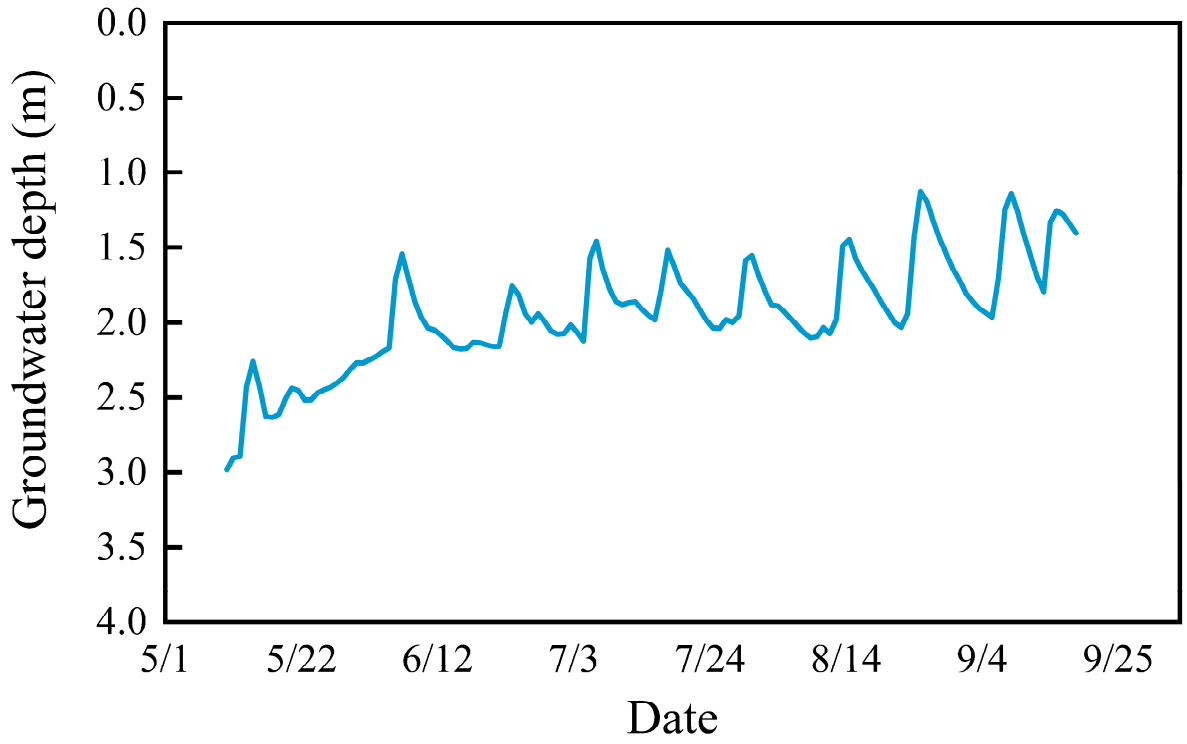


Figure S4

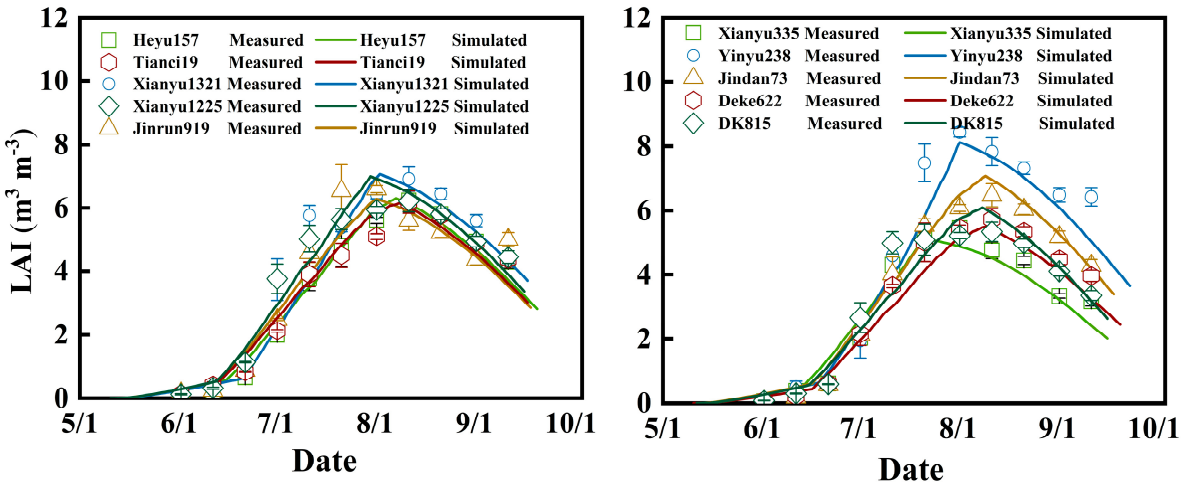

Heyu157 Measured
Tianci19 Measured
Xianyu1321 Measured
Xianyu1225 Measured
Jinrun919 Measured
Heyu157 Simulated
Tianci19 Simulated
Xianyu1321 Simulated
Xianyu1225 Simulated
Jinrun919 Simulated
LAI (m3 m-3)
Date
Xianyu335 Measured
Yinyu238 Measured
Jindan73 Measured
Deke622 Measured
DK815 Measured
Xianyu335 Simulated
Yinyu238 Simulated
Jindan73 Simulated
Deke622 Simulated
DK815 Simulated
Date

Figure S5

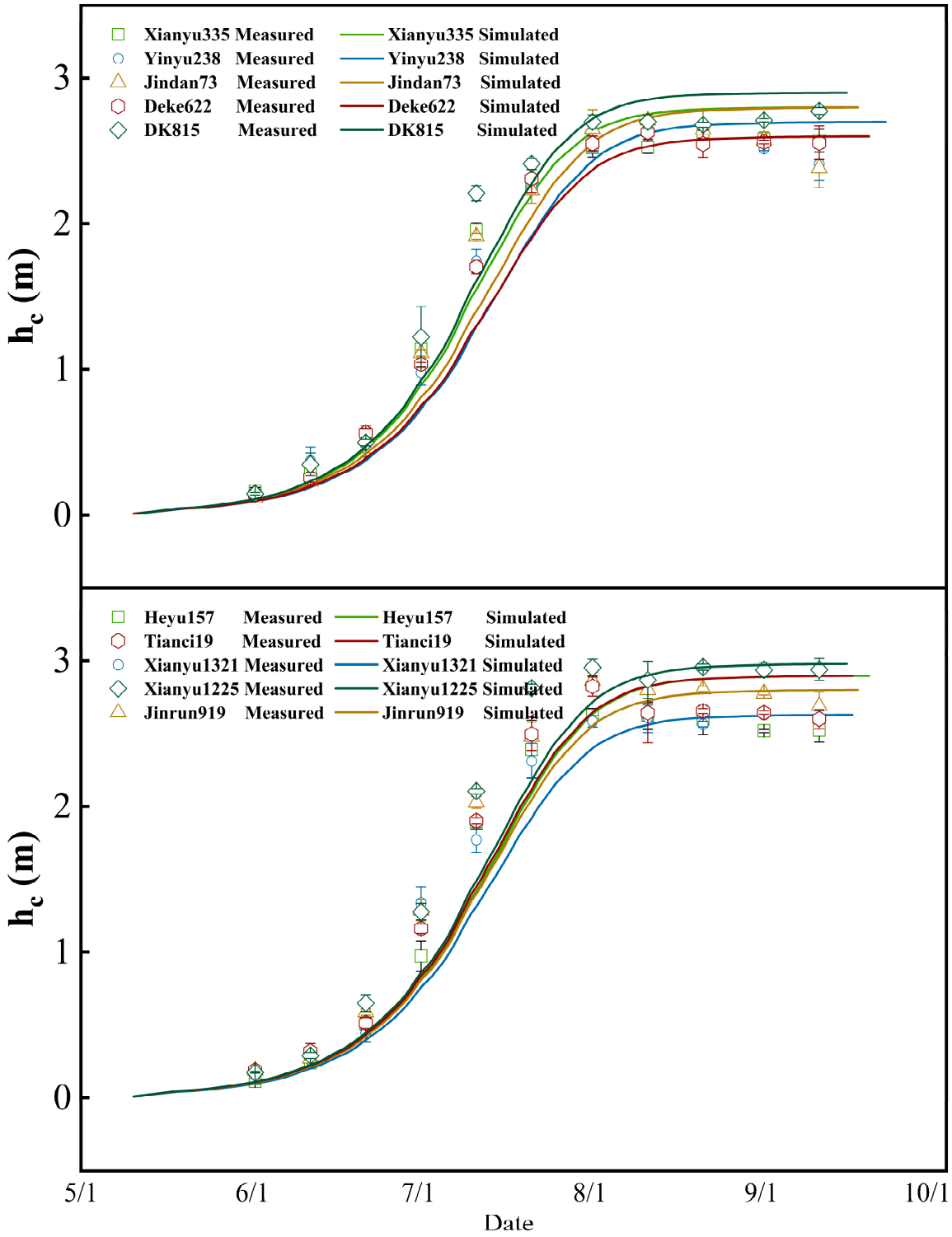

Xianyu335 Measured
Yinyu238 Measured
Jindan73 Measured
Deke622 Measured
DK815 Measured
Xianyu335 Simulated
Yinyu238 Simulated
Jindan73 Simulated
Deke622 Simulated
DK815 Simulated
Heyu157 Measured
Tianci19 Measured
Xianyu1321 Measured
Xianyu1225 Measured
Jinrun919 Measured
Heyu157 Simulated
Tianci19 Simulated
Xianyu1321 Simulated
Xianyu1225 Simulated
Jinrun919 Simulated
h_c (m)
0
1
2
3
5/1
6/1
7/1
8/1
9/1
10/1
Date

Figure S6

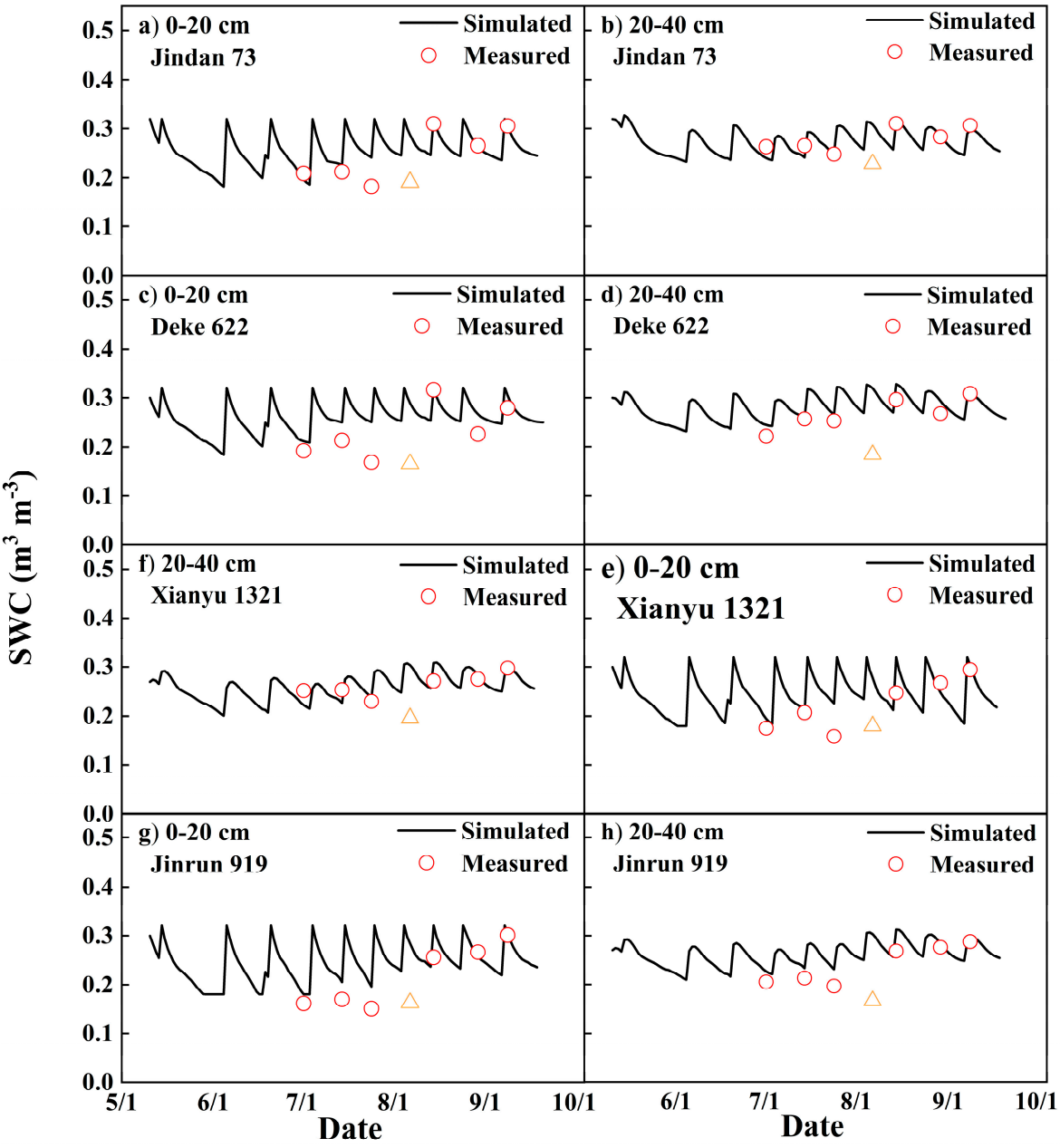

a) 0-20 cm
Jindan 73
b) 20-40 cm
Jindan 73
c) 0-20 cm
Deke 622
d) 20-40 cm
Deke 622
f) 20-40 cm
Xianyu 1321
e) 0-20 cm
Xianyu 1321
g) 0-20 cm
Jinrun 919
h) 20-40 cm
Jinrun 919
Simulated
Measured
SWC (m3 m-3)
0.0
0.1
0.2
0.3
0.4
0.5
5/1
6/1
7/1
8/1
9/1
10/1
Date

Figure S7

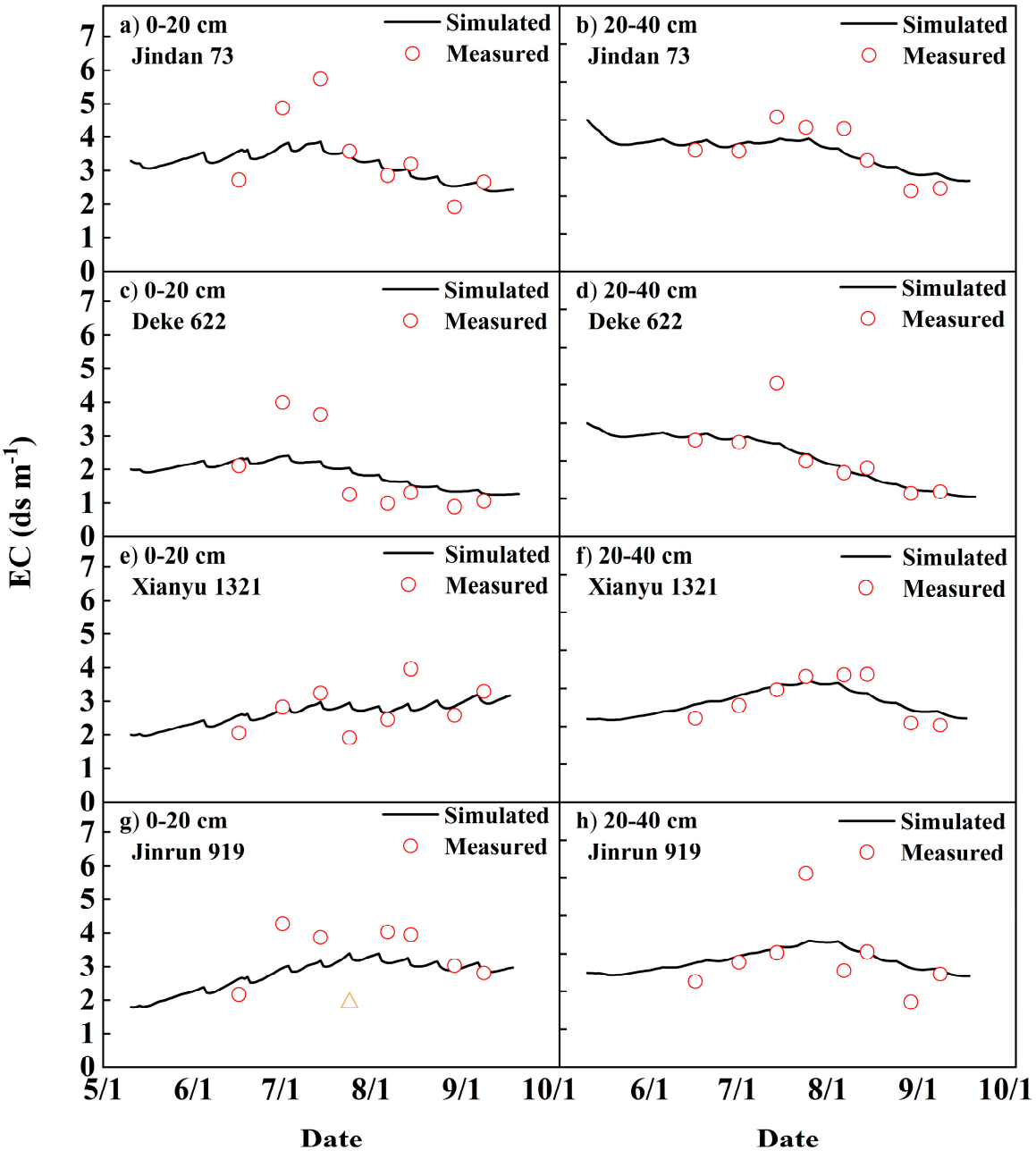

a) 0-20 cm
Jindan 73
b) 20-40 cm
Jindan 73
c) 0-20 cm
Deke 622
d) 20-40 cm
Deke 622
e) 0-20 cm
Xianyu 1321
f) 20-40 cm
Xianyu 1321
g) 0-20 cm
Jinrun 919
h) 20-40 cm
Jinrun 919
Simulated
Measured
EC (ds m-1)
0
1
2
3
4
5
6
7
5/1
6/1
7/1
8/1
9/1
10/1
Date

Figure S8

