S1 Calibrated leaf area index

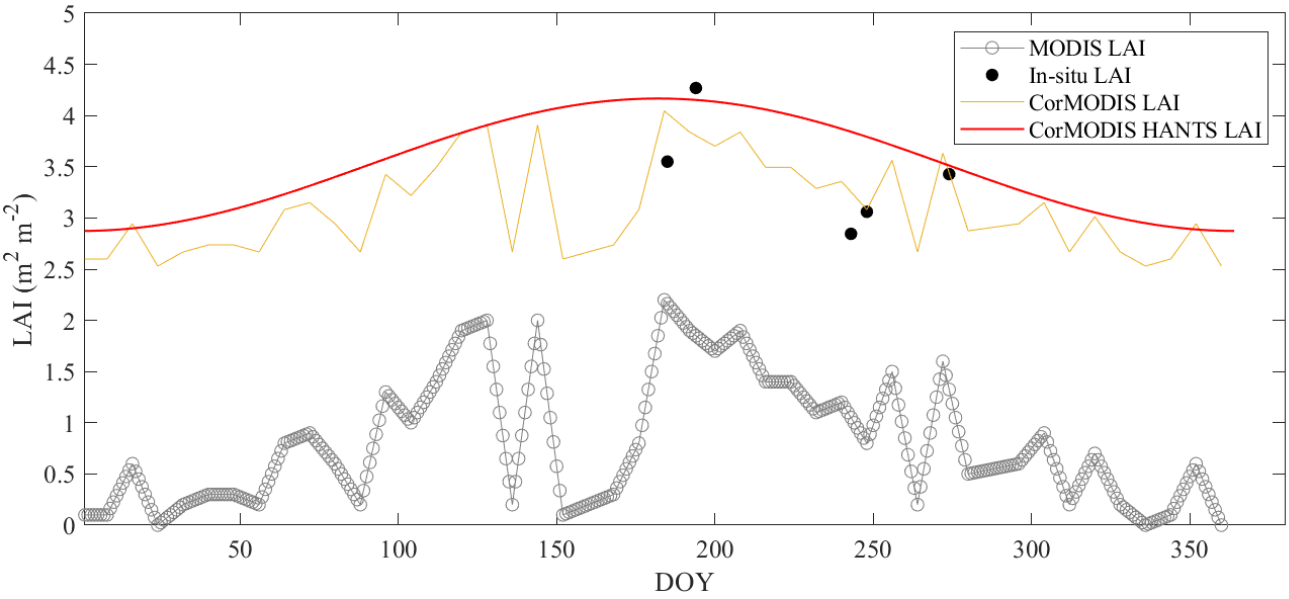

Fig. S1 Comparison between MODIS LAI and HANTS fitted LAI after bias correction with in-situ observed LAI. MODIS LAI: original LAI obtained from MODIS data; In-situ LAI: observed LAI; CorMODIS LAI: bias-corrected MODIS LAI data; CorMODIS HANTS LAI: HANTS fitted MODIS LAI after bias correction.

S2 Comparison of simulation and observation

S2.1 Soil moisture

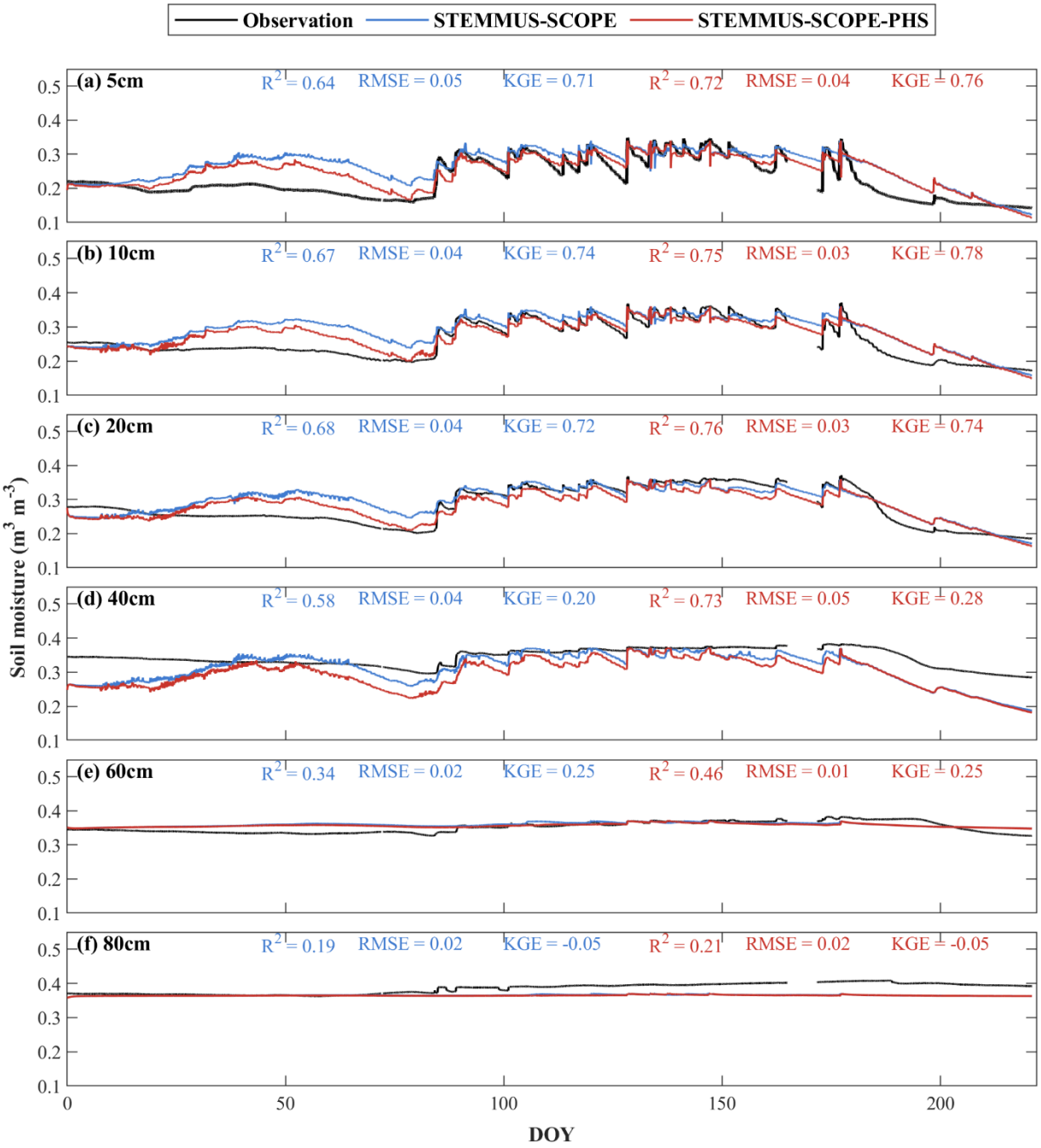

Fig. S2 Comparison of simulated and observed soil moisture at the depth of 5, 10, 20, 40, 60 and 80 cm. The blue and red lines are the results of STEMMUS-SCOPE and STEMMUS-SOCPE-PHS, respectively.

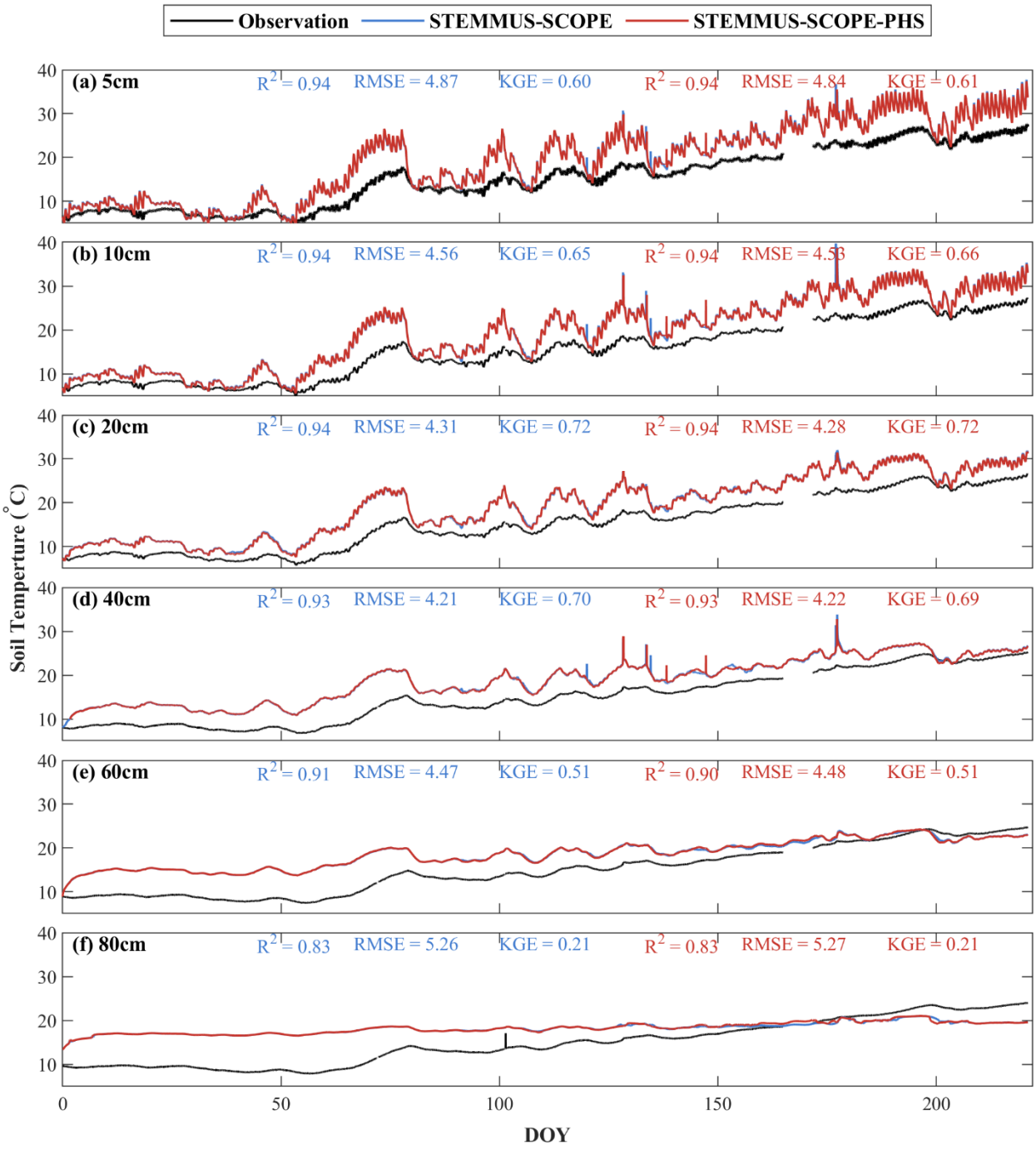

Fig. S3 Comparison of simulated and observed soil temperature at the depth of 5, 10, 20, 40, 60 and 80 cm. The blue and red lines are the results of STEMMUS-SCOPE and STEMMUS-SOCPE-PHS, respectively.

S2.3 Energy fluxes (Rn, LE, H, G)

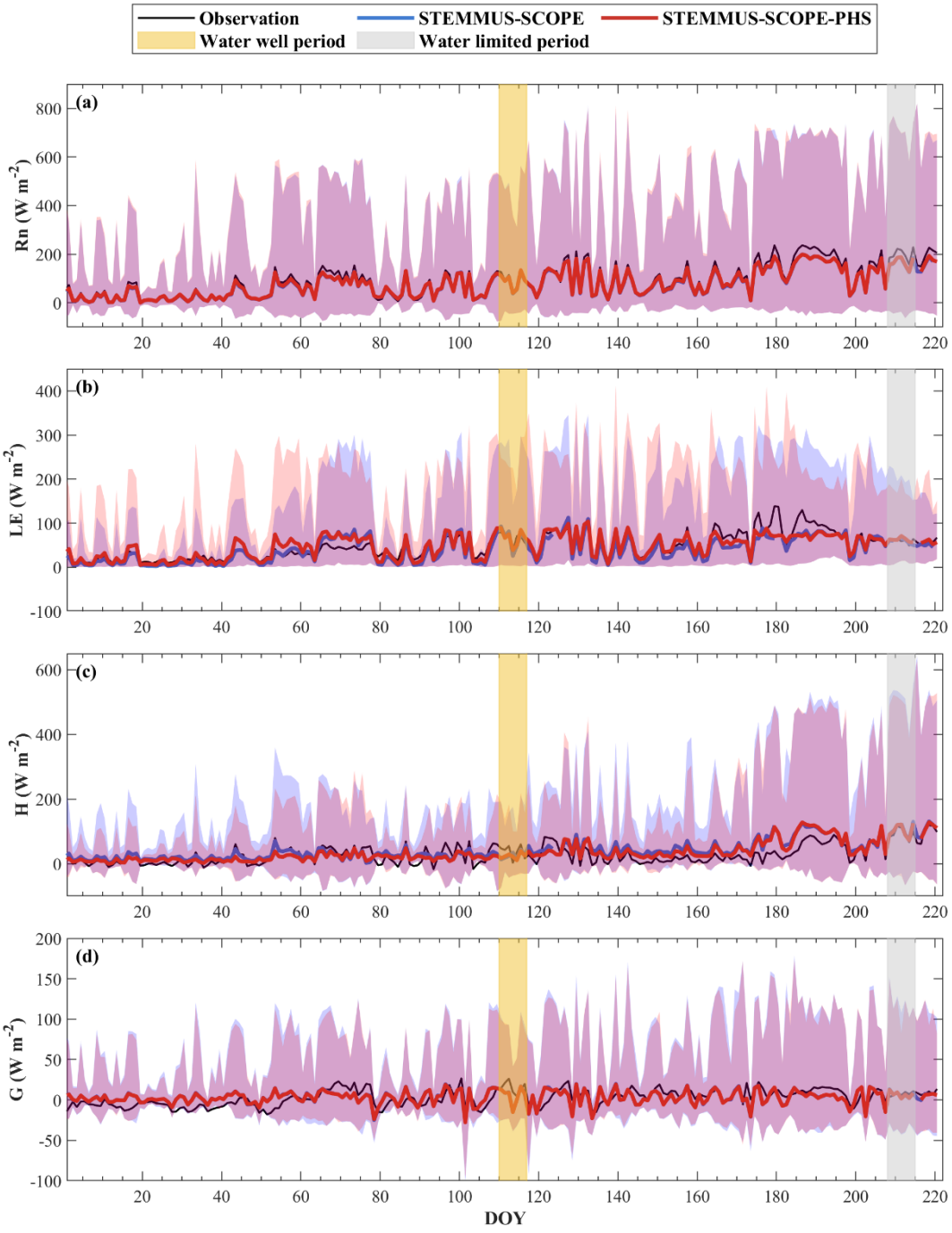

Fig. S4 Comparing simulated and observed net radiation (a), latent heat flux (b), sensible heat flux (c) and soil heat flux (d). The blue and red line are the simulation from STEMMUS-SCOPE and STEMMUS-SCOPE-PHS, respectively. The water-well period and water-limited period are marked in yellow and grey, respectively.

S2.4 Comparison of simulated and observed carbon fluxes (GPP, NEE) and SIF

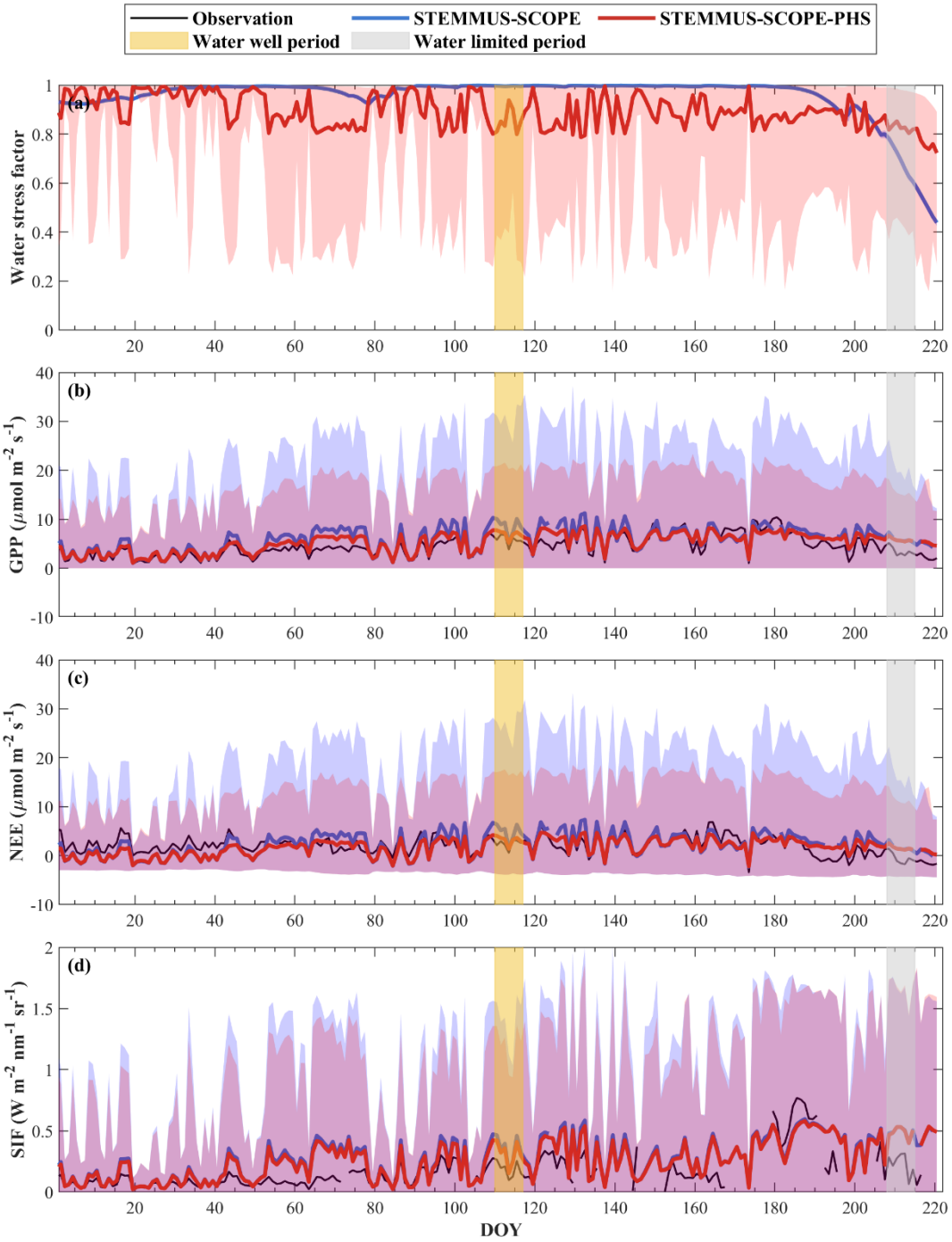

Fig. S5 Comparing (a) simulated water stress factor (b) simulated and observed GPP, (c) simulated and observed NEE, (d) simulated and observed SIF. The blue and red line are the simulation from STEMMUS-SCOPE and STEMMUS-SCOPE-PHS, respectively.

The water stress factors are not observed, so only the results from two models were shown. The water-well period and water-limited period are marked in yellow and grey, respectively.

S3 List of variables and parameters.

Table S1: Forcing data

Variables	Description	Unit
Canopy_hight	Time series canopy height	m
CO2air	Concentration of carbon dioxide	ppm
IGBP_veg_long	Plant function types	-
LAI	Leaf area index	m^2m^{-2}
LWdown	Longwave downward radiation	W m^{-2}
Precip	Precipitation	mm s^{-1}
Psurf	Air pressure	Pa
Qair	Near surface specific humidity	kg kg^{-1}
RH	Relative humidity	%
SWdown	Shortwave downward radiation	W m^{-2}
Tair	Air temperature	K
VPD	Vapor pressure deficit	hPa
Wind	Wind speed	m s^{-1}
reference_height	Reference height	m

Table S2: Initial condition

Variable	Soil Depth (cm)	Variable	Initial soil temperature ($^{\circ}C$)	Variable	Initial soil moisture ($m^3\ m^{-3}$)
-	0	InitT0	5.569	InitX0	0.2000
InitND1	5	InitT1	6.445	InitX1	0.2200
InitND2	10	InitT2	6.837	InitX2	0.2551
InitND3	20	InitT3	7.300	InitX3	0.3000
InitND4	40	InitT4	8.120	InitX4	0.3253
InitND5	60	InitT5	8.880	InitX5	0.3500
InitND6	80	InitT6	9.640	InitX6	0.3695
Tot_depth	100	BtmT	14.500	BtmX	0.3700

Table 3 Soil hydraulics parameters

Soil depth (cm)	SaturatedK (cm d^{-1})	SaturatedMC (m^3m^{-3})	ResidualMC (m^3m^{-3})	Coefficient_n (m^3m^{-3})	Coefficient_Alpha (m^3m^{-3})	FieldMC (m^3m^{-3})	Porosity (m^3m^{-3})
5	70	0.340	0.030	1.3348	0.0085	0.300	0.340
10	40	0.360	0.060	1.3100	0.0088	0.300	0.360
20	22	0.360	0.060	1.2900	0.0088	0.300	0.360
40	22	0.370	0.060	1.2800	0.0088	0.300	0.370
60	1	0.370	0.080	1.0900	0.0093	0.260	0.370
80	1	0.370	0.080	1.0900	0.0111	0.260	0.370

* SaturatedK is saturated soil hydraulic conductivity, SaturatedMC is saturated soil moisture, ResidualMC is residual soil moisture, Coefficient_n and Coefficient_Alpha are parameters in van Genuchten model, FieldMC is field capacity.

Table 4 Plant hydraulics parameter used in this study.

Parameter	Description	Unit	Value
B2C	The ratio to transfer biomass to carbon	gC gDM^{-1*}	0.488
$Kroot_{max}$	Maximum root hydraulic conductivity	m s^{-1}	2e-9
$Kstem_{max}$	Maximum stem hydraulic conductivity	m s^{-1}	4e-8
$Kleaf_{max}$	Maximum leaf hydraulic conductance	s^{-1}	4e-8
L	Root lateral length	m	0.25
$P50_{leaf}$	Water potential at 50% leaf hydraulics conductance loss	m	-67.67
$P50_{stem}$	Water potential at 50% stem hydraulic conductance loss	m	-342
$P50_{root}$	Water potential at 50% root hydraulic conductance loss	m	-30
RTB	Initial root total biomass	g m^{-2}	300
r_{root}	Root radius	m	1.5e-3
$s2l$	The fraction of stem area index (SAI) to leaf area index (LAI)	-	0.1
a_{leaf}	Shape factor	-	1.98
a_{stem}	Shape factor	-	1.98
a_{root}	Shape factor	-	0.8
ρ_{root}	Root density	gDM m^{-3}	250000

*DM is dry matter.