

Supplementary Materials

Table S1. Crop agronomic information.

Crops	Soybean	Peanut	Winter wheat	Summer maize
Variety	Jidou12	Jihua 4	Kenong 2009	Jundan 20
Total irrigation (mm)	225	225	225	75
Irrigation time	Branching, flowering, podding	Seeding, flowering, podding	Pre-wintering/ regreening stage, jointing, anthesis	Sowing
Total N (kg ha ⁻¹)	151.8	156.3	310.2	283.7
Base N (kg ha ⁻¹)	151.8	75	118.5	0
Topdressing N (kg ha ⁻¹)	0	81.3	191.7	283.7
P ₂ O ₅ (kg ha ⁻¹)	172.5	191.7	299	0
K ₂ O (kg ha ⁻¹)	150	83.3	0	0
Sowing date	Beginning of May	1–8 May	5–28 Oct	14–30 Jun
Harvest date	25 Sep	12 Sep	10–13 Jun	01–10 Oct

Note: the irrigation and fertilizer were adopted the optimized practices adopted from the local farmers' operations and our previously published optimized measurements [13,34].

Table S2. Observed crop indicator values for soybean and peanut during the calibration (2023) and validation (2021) periods.

	Soybean				Peanut				
	2 Jun	11 Jul	11 Aug	25 Sep	2 Jun	23 Jun	11 Jul	11 Aug	12 Sep
<i>Calibration (2023)</i>									
LAI	0.42	–	3.65	–	0.29	1.00	–	2.75	3.86
AGB (kg·ha ⁻¹)	354	4399	6913	7555	326	1144	2335	4734	10959
Yield (kg·ha ⁻¹)				3130					5139
<i>Validation (2021)</i>									
AGB (kg·ha ⁻¹)				9634					10537
Yield (kg·ha ⁻¹)				3945					4800

Table S3. Soil hydraulic functions parameters in model calibration.

Soil layers (cm)	ORES	OSAT	ALFA	NPAR	KSATFIT	LEXP	H_ENPR	BDENS
0-20	0.1800	0.32	0.0130	1.3000	90.00	0.5	0.0000	1367.2
20-40	0.1800	0.45	0.0132	1.3620	43.00	0.5	0.0000	1450.1
40-60	0.1400	0.30	0.0245	1.3000	73.00	0.5	0.0000	1433.9
60-80	0.0965	0.48	0.0196	1.3000	71.00	0.5	0.0000	1398.4
80-100	0.0357	0.30	0.0090	1.3200	2.00	0.5	0.0000	1398.4
100-120	0.0615	0.40	0.0100	1.3200	2.00	0.5	0.0000	1484.0
120-140	0.0363	0.31	0.0090	1.2000	0.30	0.5	0.0000	1508.2
140-160	0.0372	0.43	0.0090	1.2000	1.60	0.5	0.0000	1587.0
160-180	0.0429	0.35	0.0090	1.2500	1.60	0.5	0.0000	1587.0
180-200	0.0451	0.43	0.0090	1.200	1.60	0.5	0.0000	1587.0

Note: ORES is soil residual water content (cm³·cm⁻³), OSAT is saturated water content (cm³·cm⁻³), ALFA is parameter alfa of the main drying curve (cm), NPAR is parameter n, KSATFIT is the fitting parameter Ksat of hydraulic conductivity function (cm·d⁻¹), LEXP is the exponent in the hydraulic

conductivity function, ALFAW is the alfa parameter of the wetting curve for hysteresis (cm), H_ENPR is air entry pressure head (cm), and BDENS is dry soil bulk density ($\text{mg}\cdot\text{cm}^{-3}$).

Table S4. Comparison of simulated and observed indicators in the SWAP-WOFOST model for peanut and soybean during the calibration period.

	R^2	RMSE	MAE
Soybean LAI	–	0.07	0.05
Peanut LAI	0.999	0.13	0.107
Soybean AGB ($\text{kg}\cdot\text{ha}^{-1}$)	0.977	539.52	429.19
Peanut AGB ($\text{kg}\cdot\text{ha}^{-1}$)	0.973	750.17	547.56

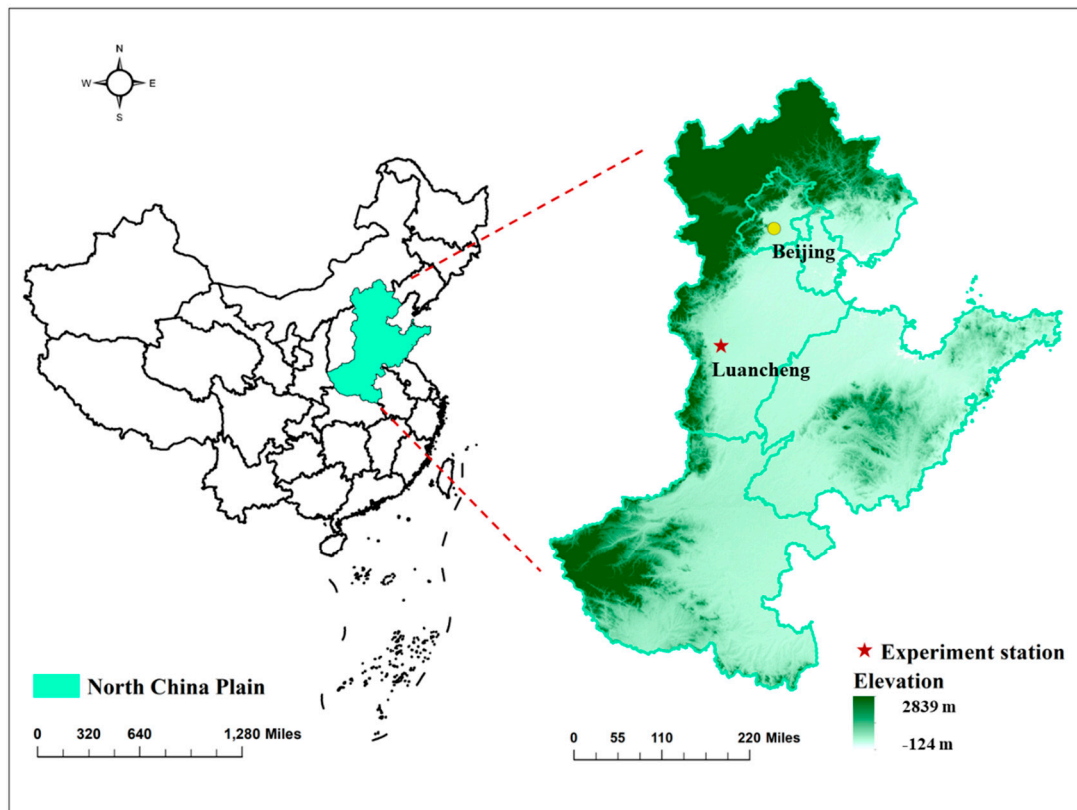


Figure S1. The location of study site.

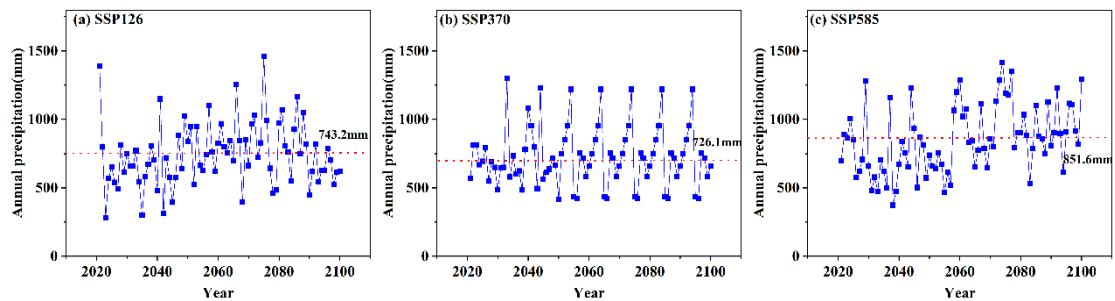


Figure S2. Annual precipitation distribution under three climate scenarios (2020–2100). The number value above the red dashed line was the average annual precipitation in three future climate scenarios.