Table S1. Equations of the modules for Energy balance, photosynthesis, and stomatal conductance.

Equation	Description	No.
Greenhouse energy balance model		
North wall energy balance		
$R_w = \rho_w c_w n_0 * \frac{dT_w}{dt} + Q^c_{w,a} + Q^{cond}_{w-w1} + Q_{w-c} + Q_{w-r} + Q_{w-s} - Q_{p-w}$	Energy balance for north wall inner surface temperature T_w.	A1
$\rho_w c_w d_1 * \frac{dT_{w1}}{dt} = \frac{k_w(T_w - T_{w1})}{n_1} - \frac{k_{w1}(T_{w1} - T_{wo})}{n_2}$	Energy balance for north wall inner sub layer.	A2
$\rho_w c_w d_2 * \frac{dT_{wo}}{dt} = \frac{k_{w1}(T_{w1} - T_{wo})}{n_2} - Q^c_{wo,T_o} - Q_{wo-sky}$	Energy balance for north wall outer sub layer.	A3
North roof energy balance		
$R_r = \rho_r c_r f_0 * \frac{dT_r}{dt} + Q^c_{r,a} + Q^{cond}_{r-r1} + Q_{r-c} + Q_{r-w} + Q_{r-s} - Q_{p-r}$	Energy balance for north roof inner surface temperature T_r	A4
$\rho_r c_r f_1 * \frac{dT_{r1}}{dt} = \frac{k_r(T_r - T_{r1})}{f_1} - \frac{k_{r1}(T_{r1} - T_{ro})}{f_2}$	Energy balance for north roof inner sub layer	A5
$\rho_r c_r f_2 * \frac{dT_{ro}}{dt} = \frac{k_{r1}(T_{r1} - T_{ro})}{f_2} - Q^c_{ro,T_o} - Q_{ro-sky}$	Energy balance for north roof outer sub layer	A6
Soil energy balance		
$R_s = \rho_s c_s z_0 * \frac{dT_s}{dt} + Q^c_{s,a} + Q^{cond}_{s-s1} + Q^l_{s,a} + Q_{s-c} + Q_{s-w} + Q_{s-r} - Q_{p-s}$	Energy balance for soil inner surface temperature T_s	A7
$\rho_s c_s z_1 * \frac{dT_{s1}}{dt} = \frac{k_s(T_s - T_{s1})}{z_1} - \frac{k_s(T_{s1} - T_{s2})}{z_2}$	Energy balance for soil first sub layer	A8
$\rho_s c_s z_2 * \frac{dT_{s2}}{dt} = \frac{k_s(T_{s1} - T_{s2})}{z_2} - \frac{k_s(T_{s2} - T_{s3})}{z_3}$	Energy balance for soil second sub layer	A9
Front cover energy balance		
$R_c = \rho_c c_c d_c * \frac{dT_c}{dt} + Q^c_{c,a} + Q^c_{c,o} + Q_{c-w} + Q_{c-r} + Q_{c-s} + Q_{c-p} + Q_{c-sky}$	Energy balance for front cover temperature T_c	A10
Indoor air energy balance		
$\rho_a c_a V_a * \frac{dT_a}{dt} = A_c Q^c_{a,c} + A_w Q^c_{a,w} + A_r Q^c_{a,r} + A_s Q^c_{a,s} + A_p Q^c_{a,p} + A_s Q^l_{s,a} + A_p Q^l_{a,p} - Q_{inf}$	Energy balance for indoor air temperature T_a	A11
Parameters calculation		
$Q^c_{A,B} = -Q^c_{B,A} = h^c_{A,B}(T_A - T_B)$	Convection energy exchange between surface A and surface B	A12
$h^c_{w,a} = h^c_{r,a} = 2.8$; $h^c_{s,a} = 1.52\lvert T_s - T_a\rvert^{0.33}$; $h^c_{c,a} = 1.95\lvert T_a - T_c\rvert^{0.3}$; $h^c_{c,o} = 2.8 + 3.0u_{out}$; $h^c_{wo,T_o} = 1.42(\frac{T_{wo} - T_o}{t})^{0.25}$; $h^c_{ro,T_o} = 1.42(\frac{T_{ro} - T_o}{t})^{0.25}$	Calculation of sensible heat exchange coefficients	A13
$Q^{cond}_{A-A1} = \frac{k_A(T_A - T_{A1})}{t}$	Conduction heat transfer from layer A to sub layer A1	A14
$Q^l_{s,a} = 0.0168 f h_{sur}[(aT_s + b) - RH(aT_a + b)]$	Soil latent energy exchange with inner air	A15
$Q_{A-B} = \epsilon_A \cdot \epsilon_B \cdot \chi_{A-B} \cdot \sigma \cdot (T_A^4 - T_B^4)$ $\quad T_A, T_B \; in \; K$	Thermal radiation exchange from unit surface A to surface B	A16
$Q_{A-sky} = \sigma \epsilon_A T_A^4 - \alpha_{ct} \sigma \epsilon_{sky} T_{sky}^4$	Radiation heat transfer from outer surface *A* to the sky	A17
$Q_{inf} = c_a \rho_a \mathrm{NH}_w (T_a - T_o)/3600$	Cold air infiltration	A18
Tomato leaf energy balance model		
$R_p = Q^c_{p,a} + Q^l_{p,a} + QE_p$	Energy balance for leaf temperature T_p	B1
$Q^c_{p,a} = 2g_h \rho_a c_a (T_p - T_a)$	Tomato leaf sensible heat exchange	B2
$Q^l_{p,a} = 2\lambda g_v (e_s(T_p) - e_a)/P_a$	Tomato leaf latent heat exchange	B3
$QE_p = \epsilon_p \cdot A_p \cdot \chi_{p-B} \cdot \sigma \cdot (T_p^4 - T_B^4)$	Leaf emitted thermal radiation	B4
$g_h = g_b * 0.135/0.147$	Leaf boundary layer conductance for heat transfer	B5
$g_v = \frac{0.5 * g_s g_b}{g_s + g_b}$	Leaf boundary layer conductance	B6
$e_s(T_p) = 0.611 \exp(\frac{17.502T}{240.97 + T})$	Leaf saturation vapour pressure at *T*	B7
Photosynthesis model (FvCB model)		
$A = V_c - 0.5V_0 - R_d = \min\{A_c, A_j, A_p\} - R_d$	Net photosynthetic rate	C1
$A_c = V_{cmax} \frac{C_c - \Gamma_*}{C_c + K_c(1 + O/K_o)}$	Rubisco-limited photosynthetic rate	C2
$A_j = \frac{J(C_i - \Gamma_*)}{4(C_i + 2\Gamma_*)}$	RuBP regeneration limited photosynthetic rate	C3

$\theta J^2 - (I_2 + J_{max})J + I_2 J_{max} = 0$	Light dependence of the rate of electron transport	C4
$I_2 = I(1-f)(1-\delta)/2$	PAR effectively absorbed by Photosystem II	C5
$A_p = 3P_u$	TPU limited photosynthetic rate	C6
$K_T = k_{25}\exp\left[E_a(T_p - 25)/\{298R(T_p + 273)\}\right]$	Arrhenius function; temperature dependence of K_c, K_o, R_d, V_{cmax}	C7
$J_{max} = J_{m25}\exp\left[\frac{(T_p-25)E_a}{R(T_p+273)298}\right]\frac{\left[1+\exp\left(\frac{S298-H}{R298}\right)\right]}{\left[1+\exp\left(\frac{S(T_p+273)-H}{R(T_p+273)}\right)\right]}$	Temperature dependence of J_{max}	C8
$\Gamma^* = 36.9 + 1.88(T_p - 25) + 0.036(T_p - 25)^2$	Temperature dependence of Γ^*	C9
$f(\xi) = d_0(1 - \exp(-d_1\xi))\exp(-d_2\xi)$	Leaf age dependence of J_{max}, V_{cmax} and P_u	C10
$C_i = C_a - A(\frac{1}{g_b} + \frac{1}{g_s})P_a$	Intercellular CO_2 concentration	C11
$C_c = C_i - \frac{A}{g_m}P_a$	Chloroplastic CO_2 concentration	C12
$g_m = \frac{\exp(c - \frac{\Delta H_a}{RT_k})}{1 + \exp(\frac{\Delta S * T_k - \Delta H_d}{RT})}$	Mesophyll conductance to CO_2	C13
Stomatal conductance model (BWB model)		
$g_s = b + mA\frac{h_s}{(C_s/P_a)}$	Stomatal conductance	D1
$\Gamma = \frac{R_d(K_c(1+O/K_o)) + V_{cmax}\Gamma_*}{V_{cmax} - R_d}$	CO_2 compensation point in the presence of R_d	D2
$C_s = C_a - \frac{A}{g_b}P_a$	Estimation of CO_2 partial pressure at the leaf surface	D3
$g_b = 0.147\sqrt{u/d}$ (Gr/Re^2 > 1)	Boundary layer conductance for water vapor	D4
$g_b = 0.055 \cdot (\frac{T_p - T_a}{d})^{1/4}$ (Gr/Re^2 < 1)		
$d = 0.72$w		
$a_h h_s^2 + b_h h_s + c_h = 0$ Where $\begin{cases} a_h = (g_1 A)/C_s \\ b_h = g_0 + g_b - (g_1 A/C_s) \\ c_h = (-R\mathrm{H}g_b) - g_0 \end{cases}$	Quadratic equation to obtain h_s by combining g_s with diffusion equation	D5

Table S2. Outer model loadings and significance. Original and sample mean for each simulated variable are shown, with standard deviation and *p*-values.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	P Values
Furrow Distance <- Canopy configuration	0.922	0.922	0.01	0
Leaflet Absorption <- Radiation	0.822	0.822	0	0
Leaflet Age <- Leaf age	1	1	0	
Leaflet Area <- Leaf area	1	1	0	
Leaflet NetPsyn <- Photosynthesis	0.83	0.83	0.001	0
Leaflet Temperature <- Temperature	0.793	0.793	0.001	0
Plant Absorption <- Radiation	0.768	0.768	0.001	0
Plant Distance <- Canopy configuration	-0.887	-0.886	0.014	0
Plant Netpsyn <- Photosynthesis	0.692	0.692	0.002	0
Plant Temperature <- Temperature	0.79	0.79	0.001	0
Planting Pattern <- Canopy configuration	0.351	0.351	0.027	0
Row Distance <- Canopy configuration	0.153	0.153	0.027	0

Table S3. The path coefficients between the latent variables. Original and sample mean between each two latent variables are shown, with standard deviation and *p*-values.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	P Values
Canopy configuration -> Photosynthesis	-0.019	-0.019	0.001	0
Canopy configuration -> Radiation	-0.036	-0.036	0.002	0
Canopy configuration -> Temperature	0.006	0.006	0	0
Leaf age -> Radiation	-0.263	-0.263	0.002	0
Leaf age -> Temperature	0.036	0.036	0	0
Leaf area -> Radiation	-0.065	-0.065	0.002	0
Leaf area -> Temperature	-0.001	-0.001	0	0
Radiation -> Photosynthesis	3.734	3.734	0.01	0
Radiation -> Temperature	1	1	0	0
Temperature -> Photosynthesis	-2.881	-2.881	0.011	0

Table S4. R^2 values for each Latent Variable in the inner model. Original and sample mean values R^2 values.

LV	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	P Values
Photosynthesis	0.94	0.737	0	0
Radiation	0.78	0.532	0	0
Temperature	0.982	0.942	0	0

Table S5. Specific indirect effects between the latent variables. Original and sample mean for each indirect path are shown, with standard deviation and *p*-values.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	P Values
Leaf age -> Radiation -> Temperature	-0.263	-0.263	0.002	0
Leaf area -> Radiation -> Temperature -> Photosynthesis	0.186	0.186	0.005	0
Canopy configuration -> Radiation -> Photosynthesis	-0.133	-0.133	0.007	0
Canopy configuration -> Temperature -> Photosynthesis	-0.017	-0.017	0.001	0
Canopy configuration -> Radiation -> Temperature	-0.036	-0.036	0.002	0
Radiation -> Temperature -> Photosynthesis	-2.881	-2.881	0.011	0
Canopy configuration -> Radiation -> Temperature -> Photosynthesis	0.103	0.103	0.006	0
Leaf area -> Radiation -> Photosynthesis	-0.241	-0.241	0.007	0
Leaf area -> Radiation -> Temperature	-0.065	-0.065	0.002	0
Leaf area -> Temperature -> Photosynthesis	0.004	0.004	0.001	0
Leaf age -> Temperature -> Photosynthesis	-0.105	-0.105	0.001	0
Leaf age -> Radiation -> Photosynthesis	-0.981	-0.981	0.007	0
Leaf age -> Radiation -> Temperature -> Photosynthesis	0.757	0.757	0.006	0