Supplementary materials:

Supplement S1:

Table S1.1: data description

Parameters	Symbol	Unit	Method	Sensor	Data processing	Measurement height (m)
Volumetric water Content	VWC	%	TOMST	TMS-4	native	-0.06
Air temperature	T_{air}	°C	TOMST	TMS-4	native	0.15
Soil temperature	T_{soil}	°C	TOMST	TMS-4	native	-0.06
Crop + Weed LAI	LAI.field	m^{-2} leaf m^{-2} soil	NDVI	Pontailler et al. (2003)	-	18
Chamber Leaf Area Index	LAIch	m^{-2} leaf m^{-2} soil	Manual, from leaflet count and SLA	-	-	crop level
Soil + crop net CO_2 fluxes in chambers, gap-filled	FCO_2ch	g C-CO_2 m^{-2} d^{-1}	Chambers	Picarro G2508	native time series, then gap-filled	0.5
Soil + crop respiration in chambers, gap-filled	Rch	g C-CO_2 m^{-2} d^{-1}	Chambers	Picarro G2508	Computed, Lloyd and Taylor (1994)	0.5

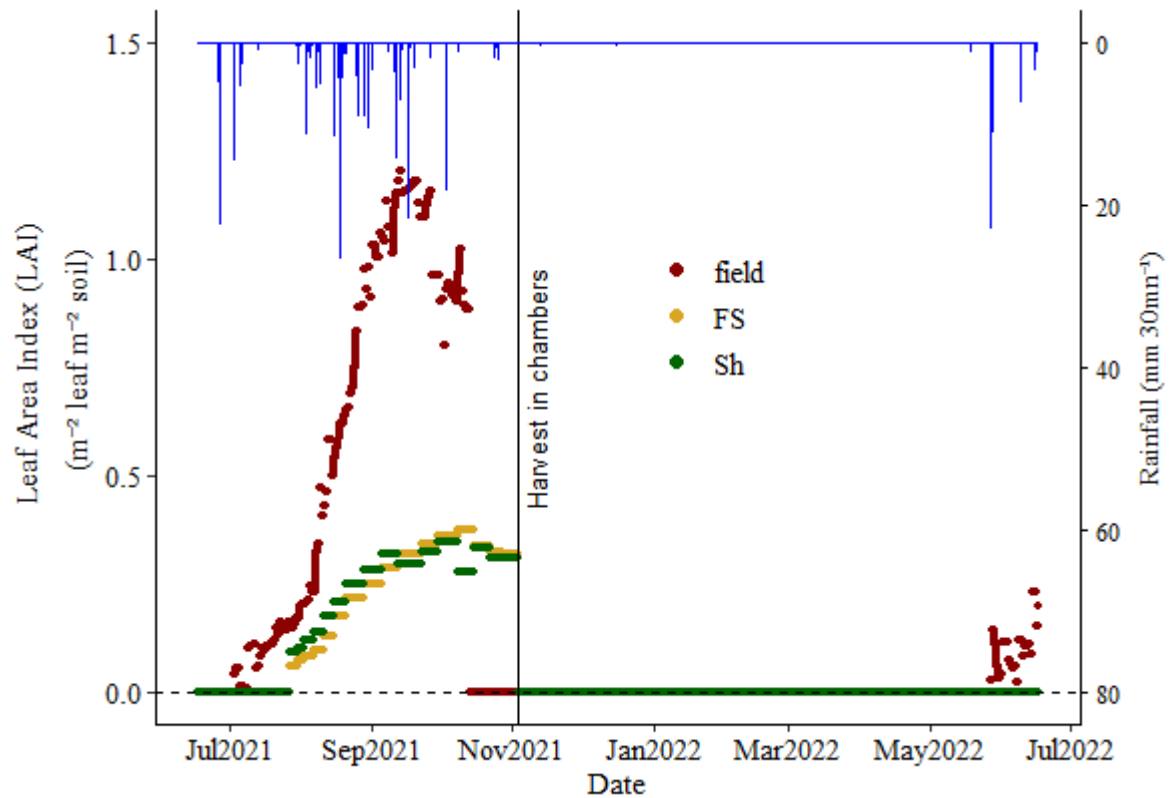| Parameters	Symbol	Unit	Method	Sensor	Data processing	Measurement height (m)
Crop Gross Primary Productivity in chambers, standardised with LAI, gap-filled	GPPch	g C-CO$_2$ m^{-2} d^{-1}	Chambers	Picarro G2508	Computed, Lasslop et al. (2010)	0.5
Global Radiation	Rg	W m^{-2}	Skye Instruments		Computed from PAR	20
Ecosystem respiration, gap-filled	Reco.EC	g C-CO$_2$ m^2 d^{-1}	EC	Smartflux	Computed ReddyProc, Lasslop et al. (2010)	20
Gross Primary Productivity, gap-filled	GPP.EC	g C-CO$_2$ m^2 d^{-1}	EC	Smartflux	Computed ReddyProc, Lasslop et al. (2010)	20
Net Ecosystem Exchange, gap-filled	NEE.EC	g C-CO$_2$ m^2 d^{-1}	EC	Smartflux	Computed ReddyProc, Lasslop et al. (2010)	20

Fig. S2.1: Dynamics of Leaf Area Index (LAI).

The red points represent the crop LAI for the entire field (LAI.field = LAI Groundnut + LAI Weed + LAI Cowpea). Yellow and green points indicate the average of LAI within full-sun and shaded chambers, respectively (LAIch = LAI of groundnut only). The blue line shows half-hourly rainfall, while the vertical solid black line marks the groundnut harvest within the chambers.
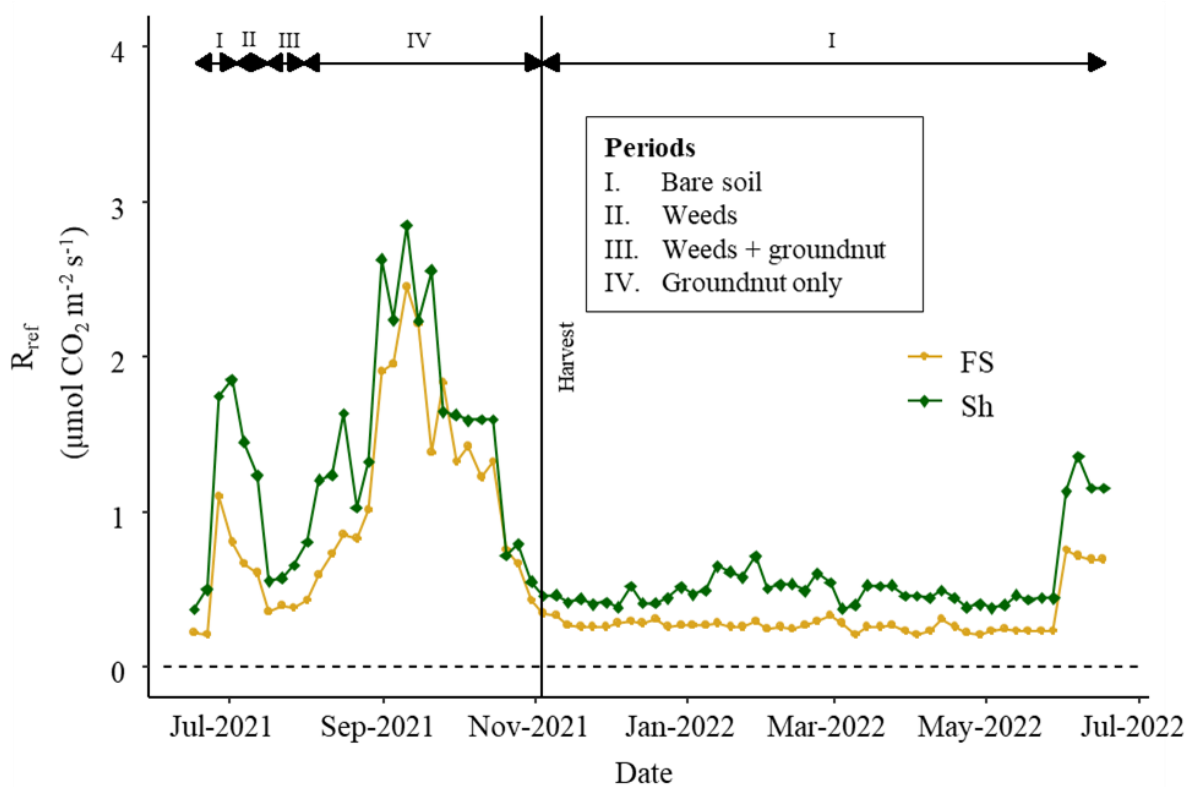
Fig. S2.2: Seasonal dynamics of the adjusted reference respiration (R_{ref}, Eq.4), a model parameter for respiration

Yellow and green lines indicate the adjusted reference respiration in full-sun and shaded chambers, respectively, while the vertical solid black line shows the groundnut harvest period within the chambers. Roman numerals (above the black arrows) refer to vegetation conditions prevailing inside the chambers: (I) bare soil, (II) weeds, (III) weeds + groundnuts, and (IV) groundnuts only.

Fig. S2.3: Seasonal dynamics of GPPch model parameters (Eq.6)

(a) the light use efficiency (α) in full-sun (yellow line, FS) and shaded chambers (green line, Sh), and (b) the maximum CO_2 uptake rate at light saturation β represented by the yellow and green lines for full-sun (FS) and shaded chambers (Sh), respectively; vertical solid black line indicates the harvest period within the chambers. Roman numerals (above the black arrows) refer to vegetation conditions prevailing inside the chambers: (I) bare soil, (II) weeds, (III) weeds + groundnuts, and (IV) groundnuts only.
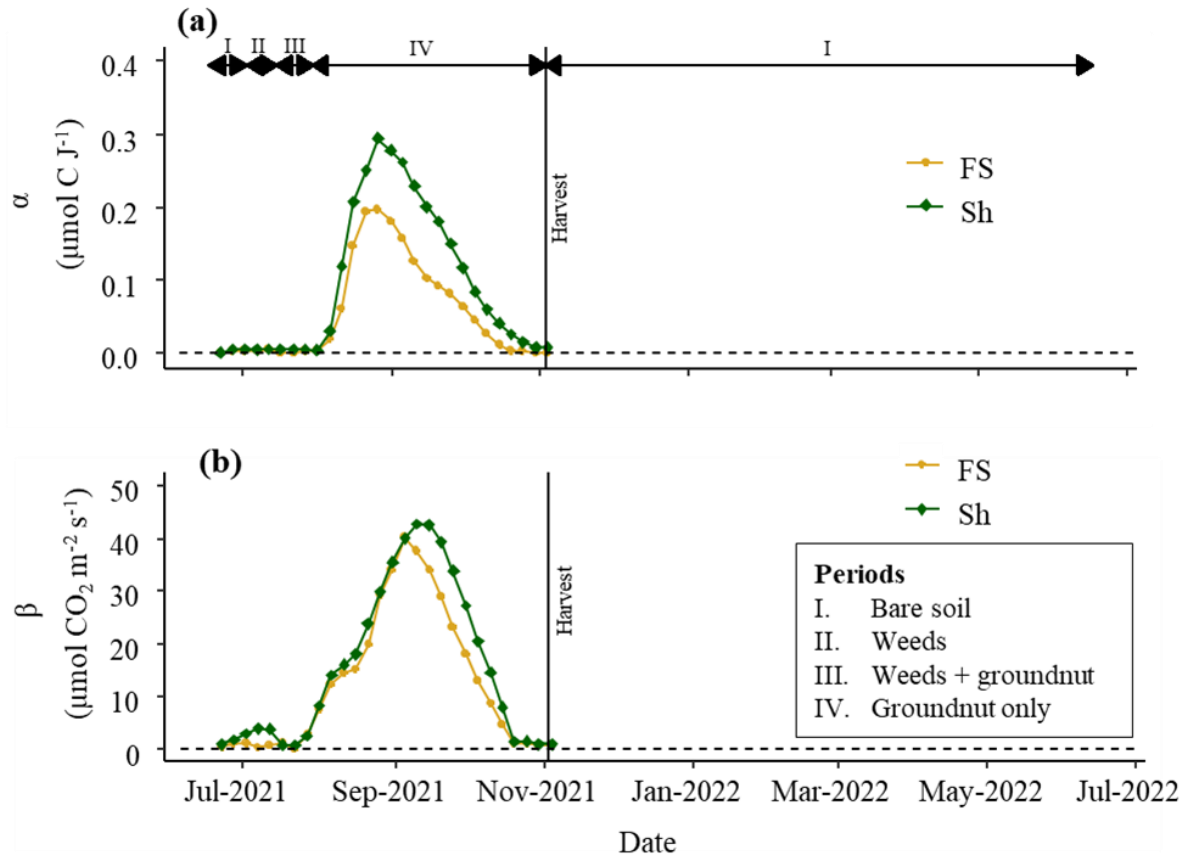
Table S2.1: Comparison of the Rch model parameter (R_{ref}) and GPPch model parameters (α and β) between the Full sun (FS) and Shaded (Sh) chambers.

	Mean $\pm$ SD	Min	Max	Mann-Whitney test
R_{ref} (μmol CO_2 m^{-2} s^{-1})				
FS	0.6 $\pm$ 0.5	0.2	2.5	
				*
Sh	0.9 $\pm$ 0.6	0.4	2.9	
α (μmol CO_2 J^{-1})				
FS	0.06 $\pm$ 0.07	<0.01	0.2	
				*
Sh	0.1 $\pm$ 0.1	<0.01	0.3	
β (μmol CO_2 m^{-2} s^{-1})				
FS	13.4 $\pm$ 13.2	<0.01	40.2	
				*
Sh	16.6 $\pm$ 15.0	0.5	42.8	

R_{ref} (μmol CO_2 m^{-2} s^{-1}), α (μmol CO_2 J^{-1}), and β (μmol CO_2 m^{-2} s^{-1}) represent, respectively, the reference respiration adjusted according to Lloyd and Taylor (1994) (Eq. 4), the light use efficiency of the plant (Groundnut) inside the chambers, and the maximum CO_2 uptake rate of the plant (groundnut) at light saturation, both adjusted following Lasslop et al. (2010) (Eq. 6). Mean, SD, Min, and Max denote the mean, standard deviation, minimum, and maximum values, respectively. Asterisks indicate the significance levels (*p value < 0.05) of the Mann-Whitney test, which assesses differences in means between FS and Sh.

(a) FS

Mean: 1.1
SD: 1
Min: 0.4
Max: 5.1
sum: 392.8

(b) Sh

Mean: 1.6
SD: 1.1
Min: 0.6
Max: 5.4
sum: 574.5

Rch Gpf (μmol C-CO^2 m^{-2} d^{-1})

(c) FS

Mean: -4.1
SD: 4.3
Min: -14.9
Max: 0
sum: -539.5

(d) Sh

Mean: -4.8
SD: 4.6
Min: -14.8
Max: -0.1
Sum: -632.6

GPPch stand. Gpf (μmol C-CO^2 m^{-2} d^{-1})

(e) FS

Mean: -0.4
SD: 2.4
Min: -11
Max: 1.8
sum: -146.7

(f) Sh

Mean: -0.2
SD: 2.7
Min: -10.9
Max: 2.8
sum: -58.1
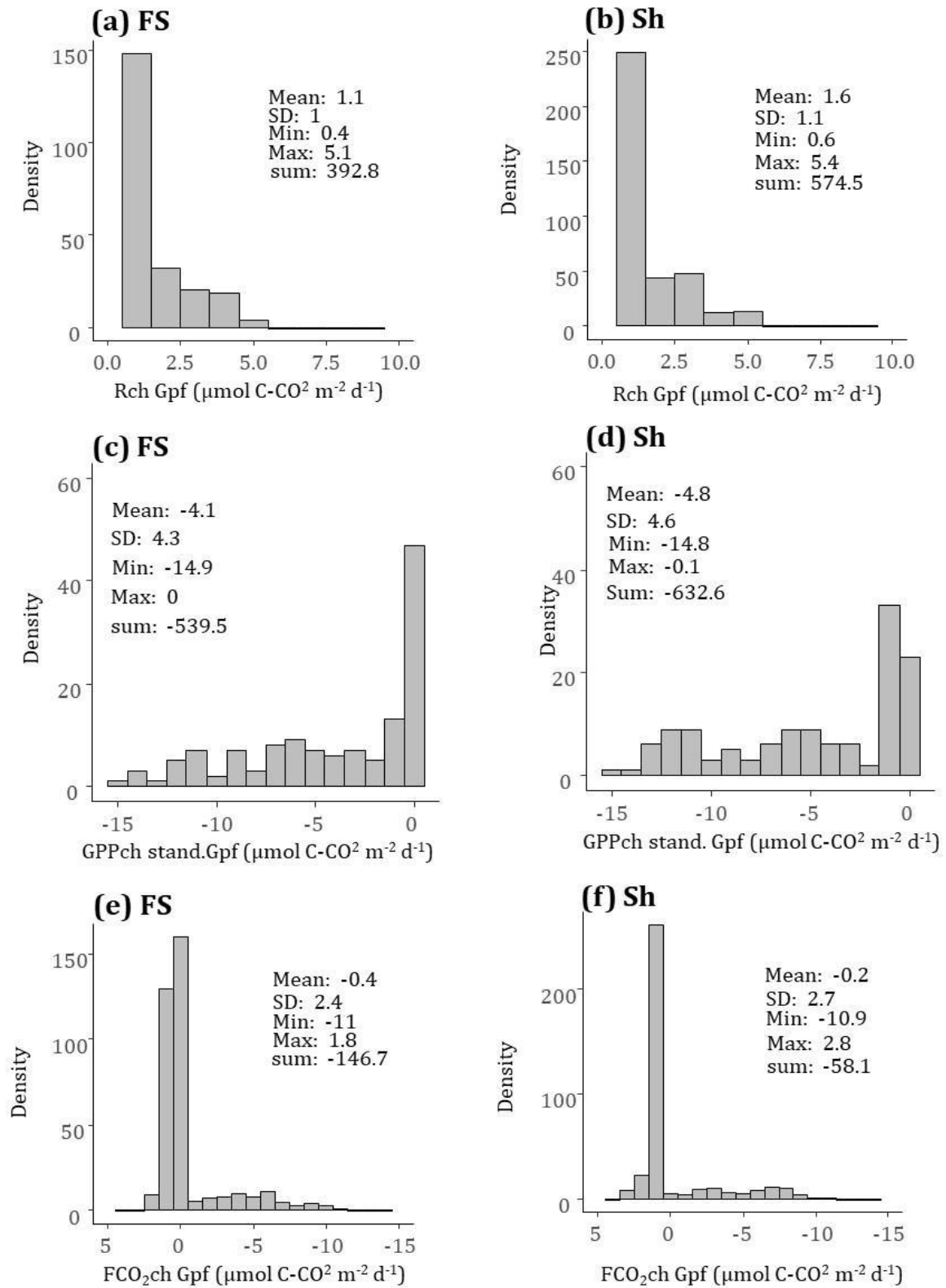
FCO$_2$ch Gpf (μmol C-CO^2 m^{-2} d^{-1})

Fig. S2.4: Density distribution of daily cumulative and gap-filled carbon flux components

Rch in (a) FS and (b) Sh, GPPch standardised for LAI in (c) FS and (d) Sh, and FCO$_2$ch in (e) FS and (f) Sh; Summary statistics (Mean, SD, Min, Max) are reported at the daily scale (g C-CO$_2$ m^{-2} d^{-1}).
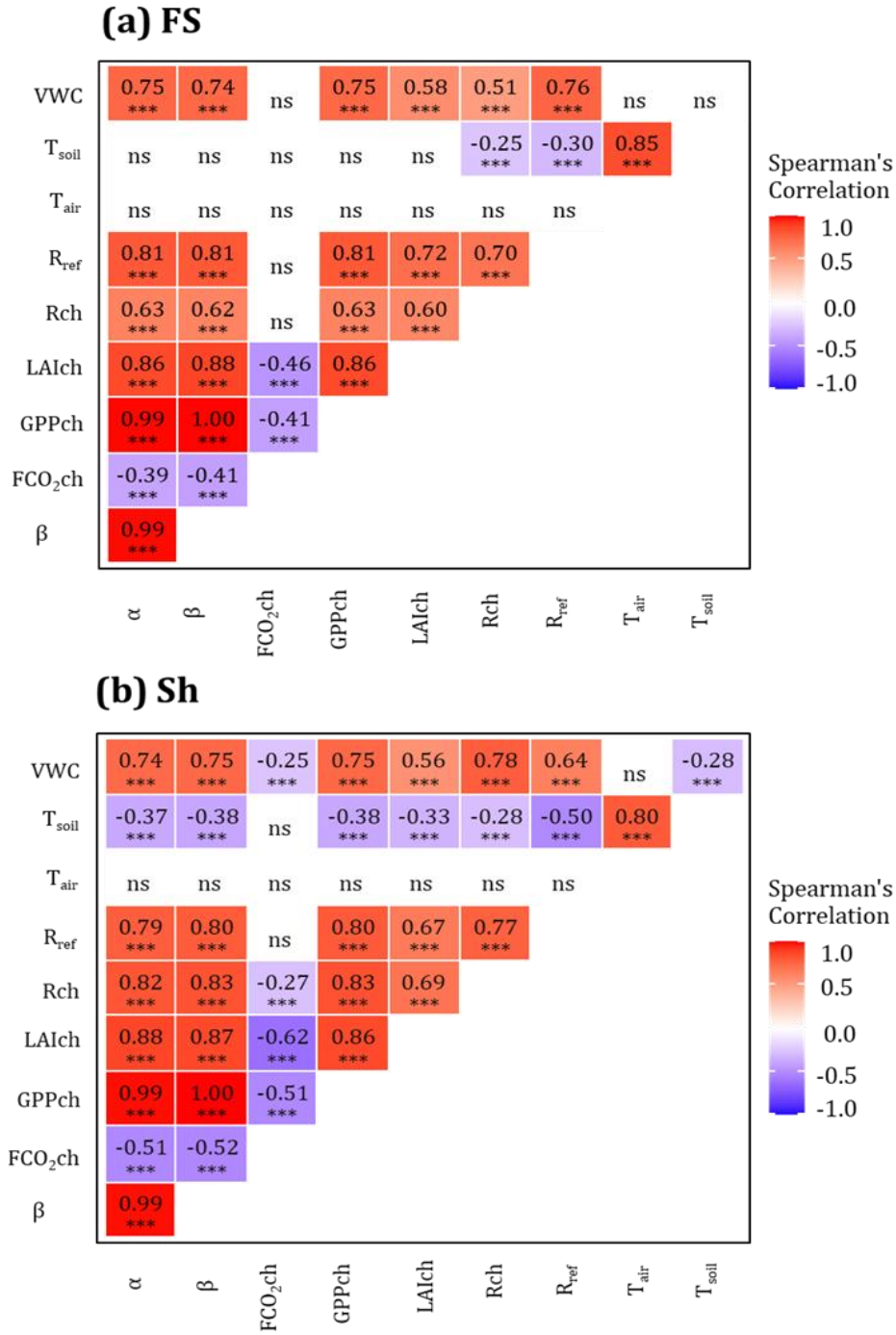
Fig. S2.5: Correlation matrices between daily cumulative CO_2 flux components for chambers (Rch, GPPch in absolute terms, and FCO_2ch, in g C-CO_2 m^{-2} d^{-1}) and daily mean microclimatic parameters, as well as between R_{ref} (Eq.4), α and β (Eq.7).

(a) full-sun chambers (FS) and (b) shaded chambers (Sh). The climatic parameters analyzed include soil temperature at 6 cm depth (T_{soil}, °C), air temperature at 15 cm height (T_{air}, °C), volumetric water content (VWC, %), and chamber leaf area index (LAIch, m^{-2} leaf m^{-2} soil). Statistical significance is denoted by (***) $p<0.001$ and ns indicate « non-significant » coefficient.
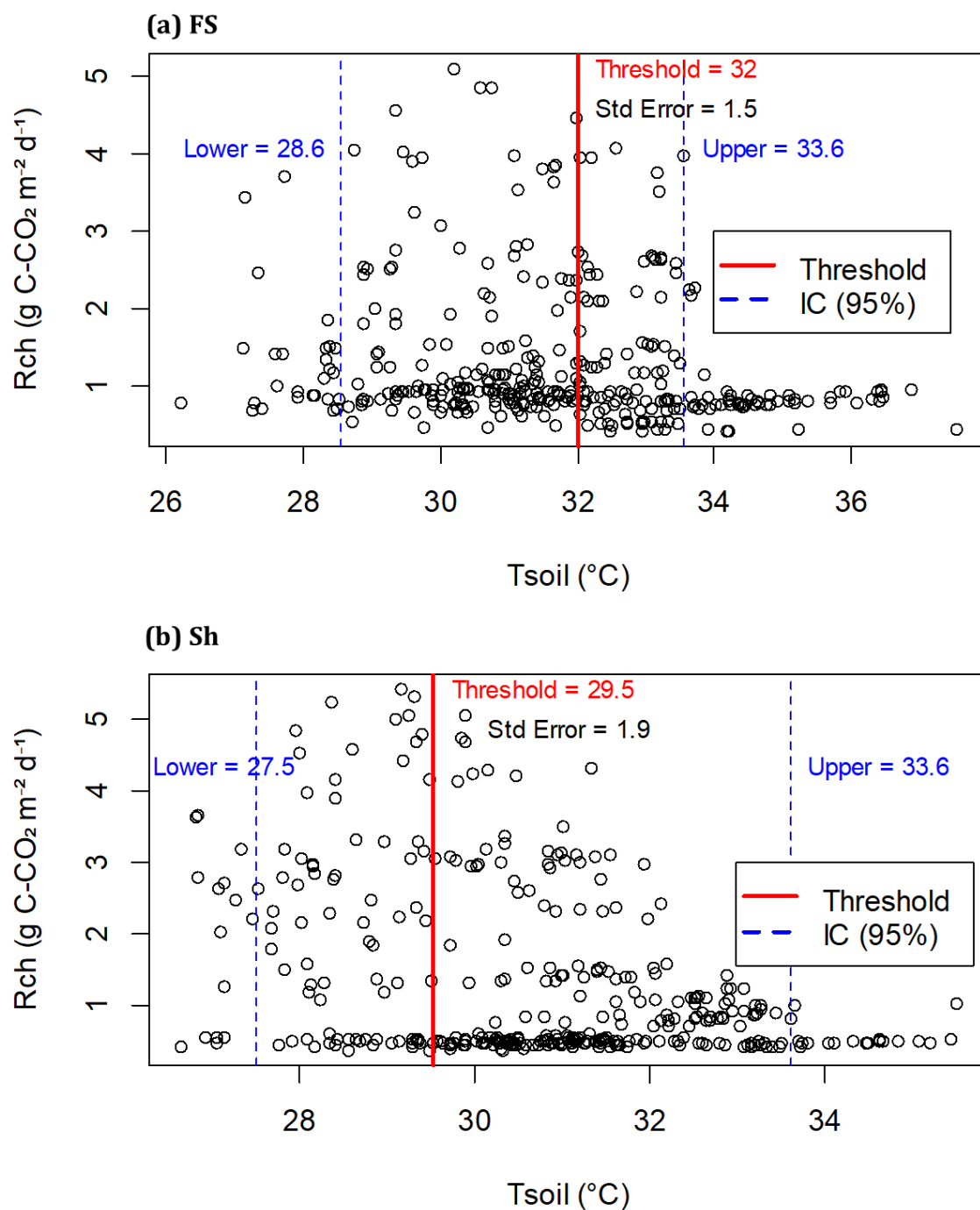
Fig. S2.6: Relationship between daily mean soil temperature (T_{soil}, °C) and daily cumulative chamber respiration (Rch, g C-CO_2 m^{-2} d^{-1}).

(a) Full-sun chambers (FS) and (b) shaded chambers (Sh). The red line indicates the threshold at which the slope of the relationship between T_{soil} and Rch changes significantly. The blue dashed lines represent the 95% confidence interval for the threshold, with lower and upper bounds.

Supplement S3:

Table S3.1: Comparison of CO_2 fluxes between Ch.stand and EC measurements according to the season.

Method	Flux	Wet season (July-Sept): Tree + Groundnut + Cowpea + Weeds	Dry Season (October-June): Tree + bare soil	Full Year (Mg C-CO_2 ha^{-1})
EC	GPP.EC	= GPP Groundnut + GPP weeds + GPP cowpea **(1)**	= GPP tree **(5)**	-11.8
	Reco.EC	= Ra tree AG + Ra tree BG + Ra Groundnut + Ra Weeds + Ra Cowpea + Rh **(2)**	= Ra tree+Rh = Ra tree AG + Ra tree BG + Rh = Ra tree AG + Rch **(6)**	10
	NEE.EC	= (1) + (2)	= (5) + (6)	-1.8
Ch.stand (upscaled)	Rch.stand	= Ra Groundnut + Ra tree BG + Rh **(3)**	= Ra tree BG + Rh **(7)**	4.1
	GPPch.stand	= GPP Groundnut + GPP Weeds + GPP Cowpea **(4)**	= 0, no plants in the chambers	-5.5
	FCO$_2$ch.stand	= (3) + (4)	= (7)	-1.4
Hypothesis to test		GPP.EC = GPPch.stand ?	Reco-EC = Ra tree AG + Rch.stand Ra tree AG = Reco EC – Rch.stand Ra tree = ± Ratree AG * 1.3 CUE = NPP tree / GPP tree CUE = (GPP tree- Ra tree) / GPP tree **= 0.48 = ca. 0.5 (8)?**	

Ra tree AG and Ra tree BG represent the autotrophic respiration from above-ground tree's biomass and below-ground tree's biomass.