Table S1. The amount of carbon (C) input of different sites in modeling experiments. Please see Table 1 for abbreviations.

Site	DOC input only (g C kg^{-1} soil year^{-1})		DOC+POC input (g C kg^{-1} soil year^{-1})	
	DOC	POC	DOC	POC
DL$_{in}$	6	0	6	6
DL$_{out}$	10	0	10	10
GY$_{in}$	4	0	4	4
GY$_{out}$	4	0	4	4
HL$_{in}$	2	0	2	2
HL$_{out}$	2	0	2	2
XL$_{in}$	2	0	2	2
XL$_{out}$	2	0	2	2
XH$_{in}$	2	0	2	2
XH$_{out}$	2	0	2	2

Table S2. Results of the two-way analysis of variance (ANOVA) on the effects of sites, fencing, and their interaction (sites: fencing) on glucose-derived SOC, MAOC, POC, MBC, and DOC. The SOC content is the sum of the sizes of the other four carbon pools combined.

	Df	Sum Sq	F-value	P-value
Glucose-derived SOC				
Sites	4	3.85×10^{-2}	1.10×10^{2}	**<0.001**
Fencing	1	9.00×10^{-5}	9.75×10^{-1}	0.331
Sites: Fencing	4	9.00×10^{-4}	2.58	0.058
Residuals	30	2.62×10^{-3}		
Glucose-derived MAOC				
Sites	4	3.94×10^{-3}	3.95×10^{1}	**<0.001**
Fencing	1	3.18×10^{-4}	1.27×10^{1}	**<0.01**
Sites: Fencing	4	4.78×10^{-4}	4.79	**<0.01**
Residuals	30	7.48×10^{-4}		
Glucose-derived POC				
Sites	4	7.15×10^{-3}	1.74×10^{2}	**<0.001**
Fencing	1	4.00×10^{-5}	3.85	0.059
Sites: Fencing	4	7.78×10^{-4}	1.90×10^{1}	**<0.001**
Residuals	30	3.08×10^{-4}		
Glucose-derived MBC				
Sites	4	4.43×10^{-3}	1.83×10^{1}	**<0.001**
Fencing	1	6.00×10^{-6}	1.02×10^{-1}	0.752
Sites: Fencing	4	2.28×10^{-4}	9.37×10^{-1}	0.456
Residuals	30	1.82×10^{-3}		
Glucose-derived DOC				
Sites	4	1.62×10^{-7}	8.89	**<0.001**
Fencing	1	3.42×10^{-8}	7.50	**<0.05**
Sites: Fencing	4	5.08×10^{-8}	2.78	**<0.05**
Residuals	30	1.37×10^{-7}		

Table S3. The posterior maximum likelihood estimates (MLE) of the parameters.

Parameter	DL_{in}		DL_{out}		GY_{in}		GY_{out}		HL_{in}	
	model I	model II	model I	model II	model I	model II	model I	model II	model I	model II
f_P	0.326	0.327	0.406	0.408	0.290	0.290	0.290	0.290	0.289	0.290
k_D	1.86×10^{-2}	1.87×10^{-2}	2.26×10^{-2}	2.23×10^{-2}	2.01×10^{-2}	2.09×10^{-2}	1.45×10^{-2}	1.45×10^{-2}	1.64×10^{-2}	1.68×10^{-2}
k_B	6.05×10^{-4}	6.05×10^{-4}	2.48×10^{-3}	2.37×10^{-3}	2.86×10^{-3}	3.01×10^{-3}	1.92×10^{-3}	2.80×10^{-3}	6.99×10^{-4}	7.50×10^{-4}
k_P	3.95×10^{-4}	3.97×10^{-4}	2.65×10^{-4}	2.68×10^{-4}	2.02×10^{-4}	2.07×10^{-4}	2.64×10^{-4}	2.74×10^{-4}	4.97×10^{-5}	5.99×10^{-5}
k_M	6.00×10^{-5}	5.94×10^{-5}	3.70×10^{-5}	3.71×10^{-5}	9.31×10^{-5}	9.89×10^{-5}	7.92×10^{-5}	8.32×10^{-5}	4.17×10^{-6}	4.65×10^{-6}
f_{MB}	0.350	0.350	0.349	0.349	0.350	0.350	0.353	0.353	0.384	0.378
f_{MP}	0.087	0.086	0.074	0.068	0.096	0.092	0.119	0.115	0.170	0.152
f_{PB}	-	0.293	-	0.261	-	0.249	-	0.253	-	0.253
f_{DP}	0.260	0.260	0.225	0.205	0.550	0.551	0.554	0.553	0.578	0.570
f_{DM}	0.340	0.339	0.340	0.335	0.454	0.448	0.475	0.468	0.514	0.490
f_{BD}	0.238	0.236	0.377	0.369	0.554	0.552	0.560	0.559	0.652	0.647

Parameter	HL_{out}		XL_{in}		XL_{out}		XH_{in}		XH_{out}	
	model I	model II	model I	model II	model I	model II	model I	model II	model I	model II
f_P	0.203	0.203	0.290	0.290	0.290	0.290	0.193	0.195	0.200	0.198
k_D	7.45×10^{-3}	7.52×10^{-3}	1.52×10^{-2}	1.58×10^{-2}	7.83×10^{-3}	8.23×10^{-3}	3.01×10^{-2}	3.34×10^{-2}	2.96×10^{-2}	2.88×10^{-2}
k_B	5.75×10^{-4}	5.76×10^{-4}	5.27×10^{-4}	5.41×10^{-4}	1.06×10^{-3}	1.27×10^{-3}	1.18×10^{-2}	1.43×10^{-2}	7.82×10^{-3}	1.39×10^{-2}
k_P	6.86×10^{-5}	6.77×10^{-5}	1.60×10^{-4}	1.71×10^{-4}	1.60×10^{-4}	1.70×10^{-4}	3.66×10^{-3}	4.04×10^{-3}	2.85×10^{-3}	3.88×10^{-3}
k_M	6.26×10^{-6}	6.28×10^{-6}	1.65×10^{-5}	1.71×10^{-5}	4.07×10^{-5}	4.17×10^{-5}	4.42×10^{-4}	5.17×10^{-4}	6.13×10^{-4}	6.77×10^{-4}
f_{MB}	0.349	0.350	0.350	0.350	0.306	0.302	0.288	0.269	0.526	0.461
f_{MP}	0.092	0.094	0.102	0.100	0.103	0.102	0.368	0.342	0.541	0.506
f_{PB}	-	0.096	-	0.250	-	0.252	-	0.368	-	0.385
f_{DP}	0.550	0.550	0.550	0.551	0.552	0.551	0.567	0.570	0.589	0.581
f_{DM}	0.446	0.449	0.451	0.449	0.457	0.455	0.524	0.517	0.563	0.483
f_{BD}	0.652	0.651	0.653	0.654	0.657	0.656	0.690	0.683	0.801	0.791
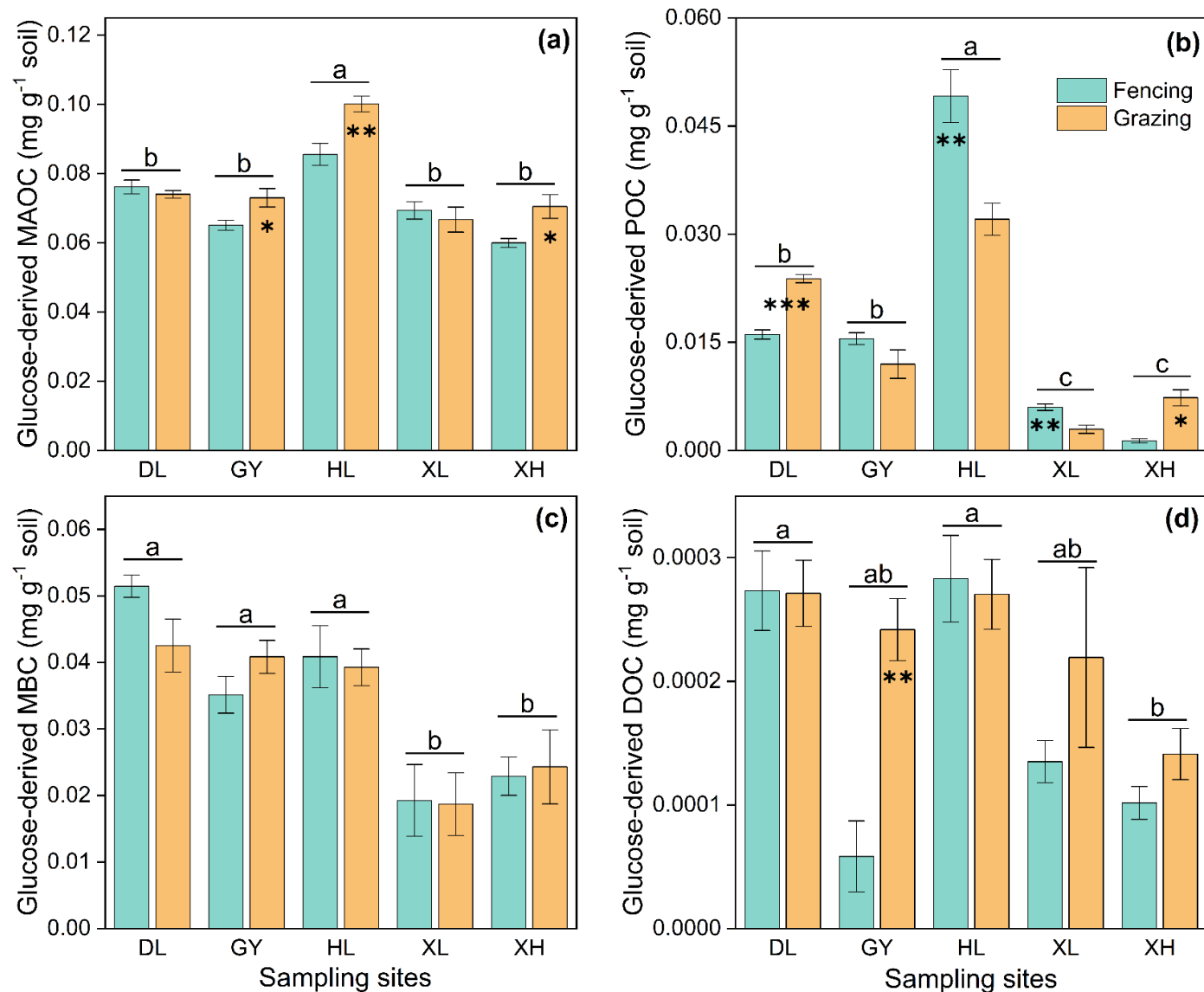
Figure S1. **Response of carbon (C) sequestration to sites and fencing. a**. Glucose-derived MAOC; **b**. Glucose-derived POC; **c**. Glucose-derived MBC; **d**. Glucose-derived DOC. Different letters above bars represent significant differences among sites ($P < 0.05$). Asterisks represent significant differences between grazing and fencing treatment (*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$).
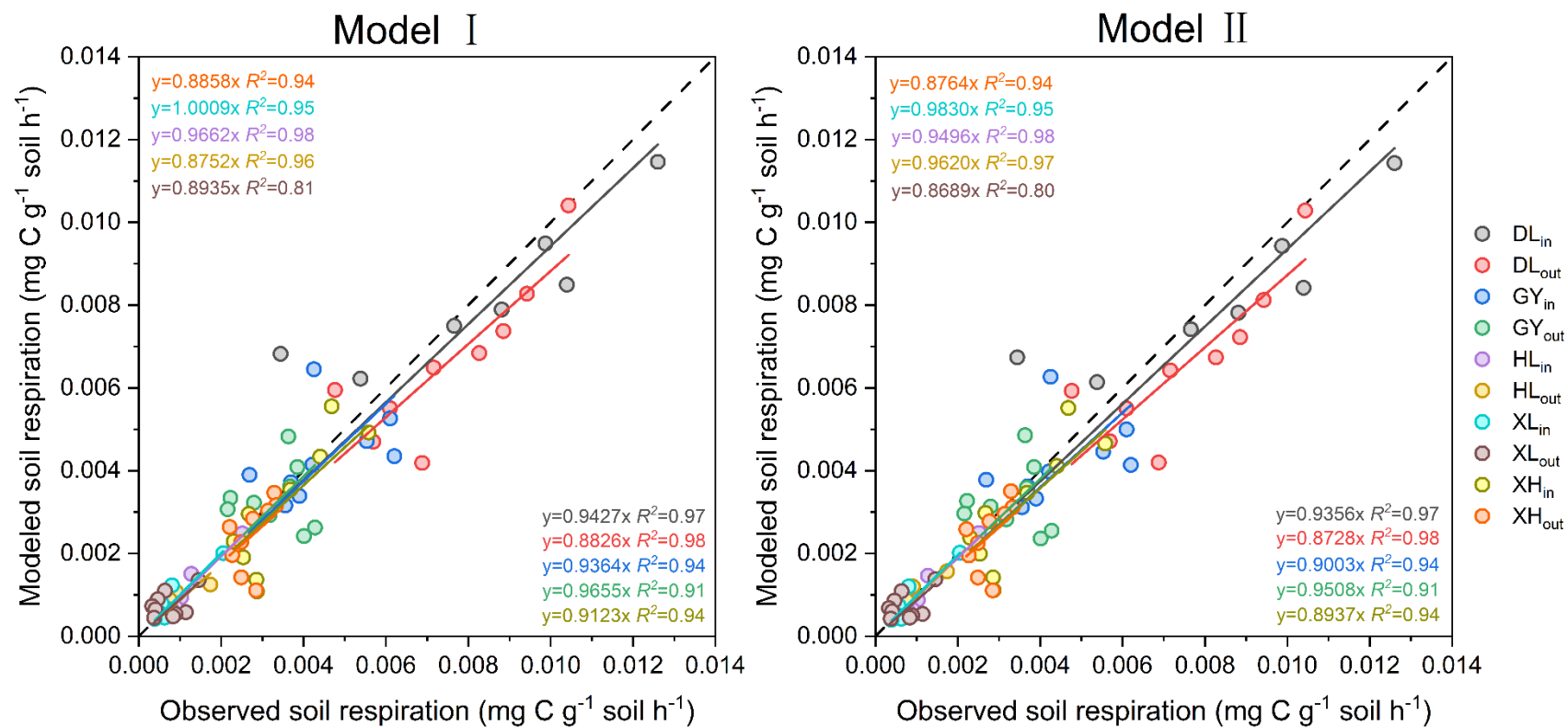
Figure S2. Comparison of observed and modeled CO₂ flux in the incubation experiment. Diagonal black dotted line is 1:1 line.
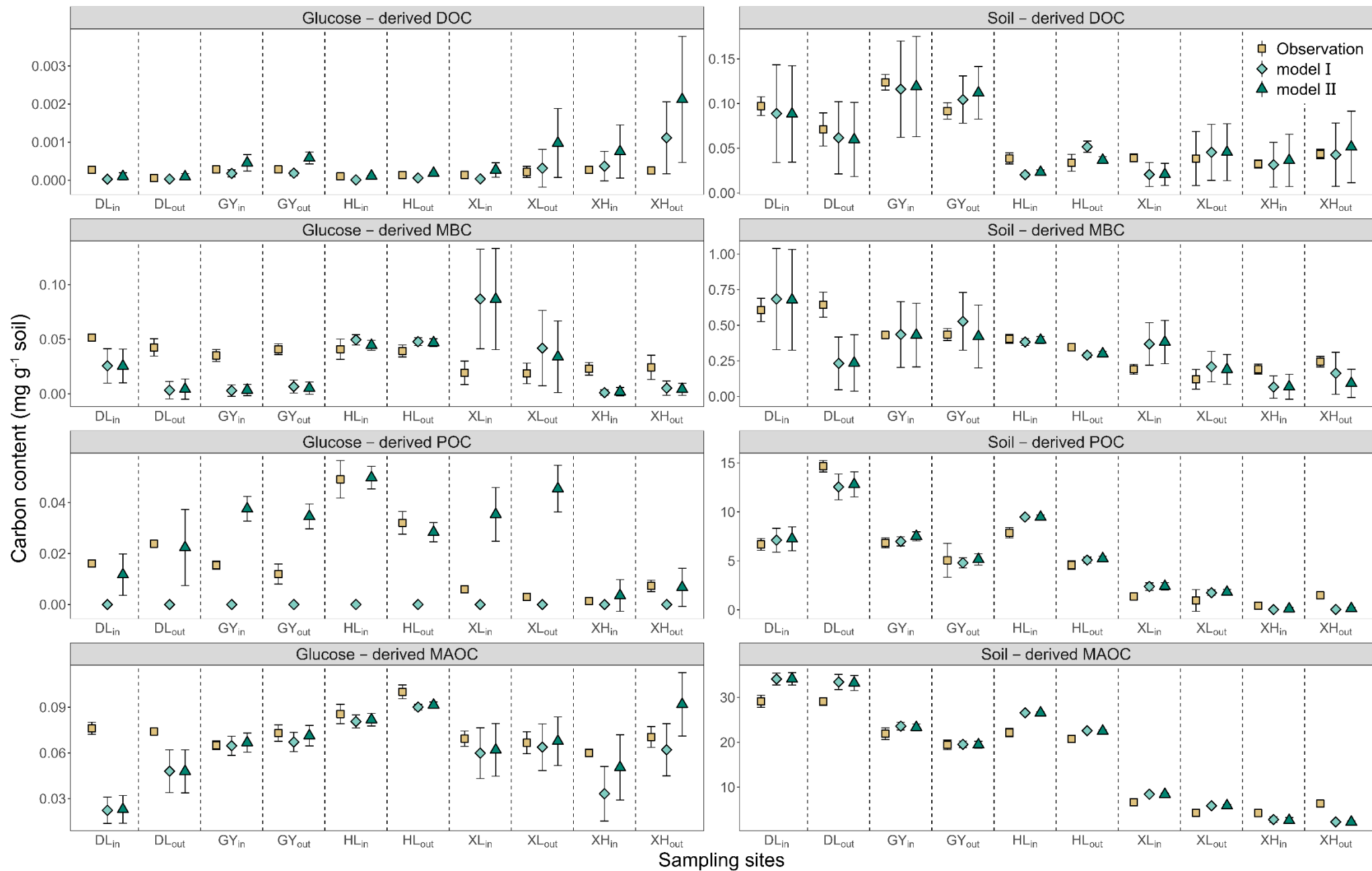
Figure S3. Observed and modeled soil C pools by Model I and II. The error bars represent the standard deviation of each dataset.
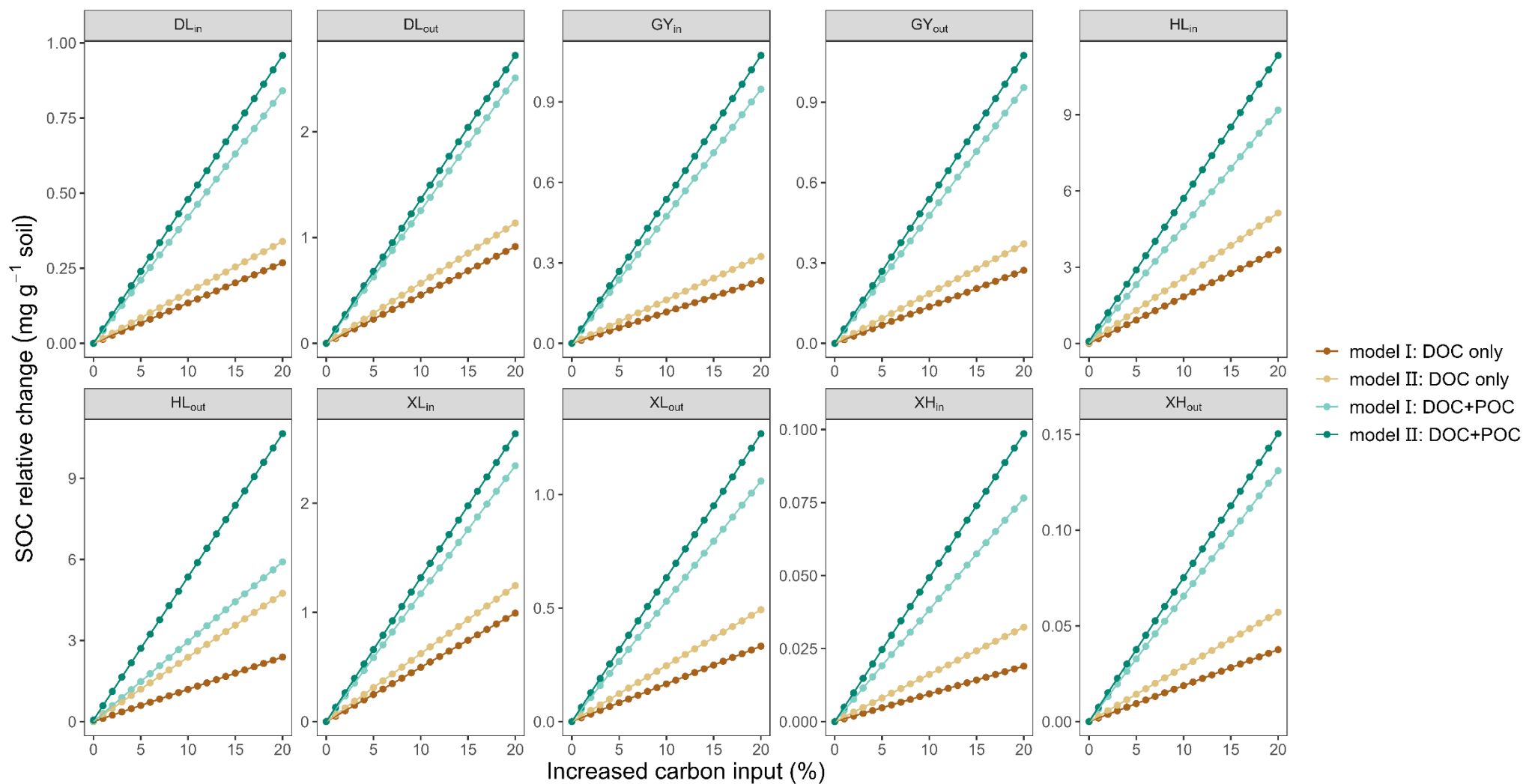
Figure S4. Continuous relative changes in the steady state along a gradient of C input increase under two types of C input conditions. C input increase from 1% to 20% with a 1% interval.
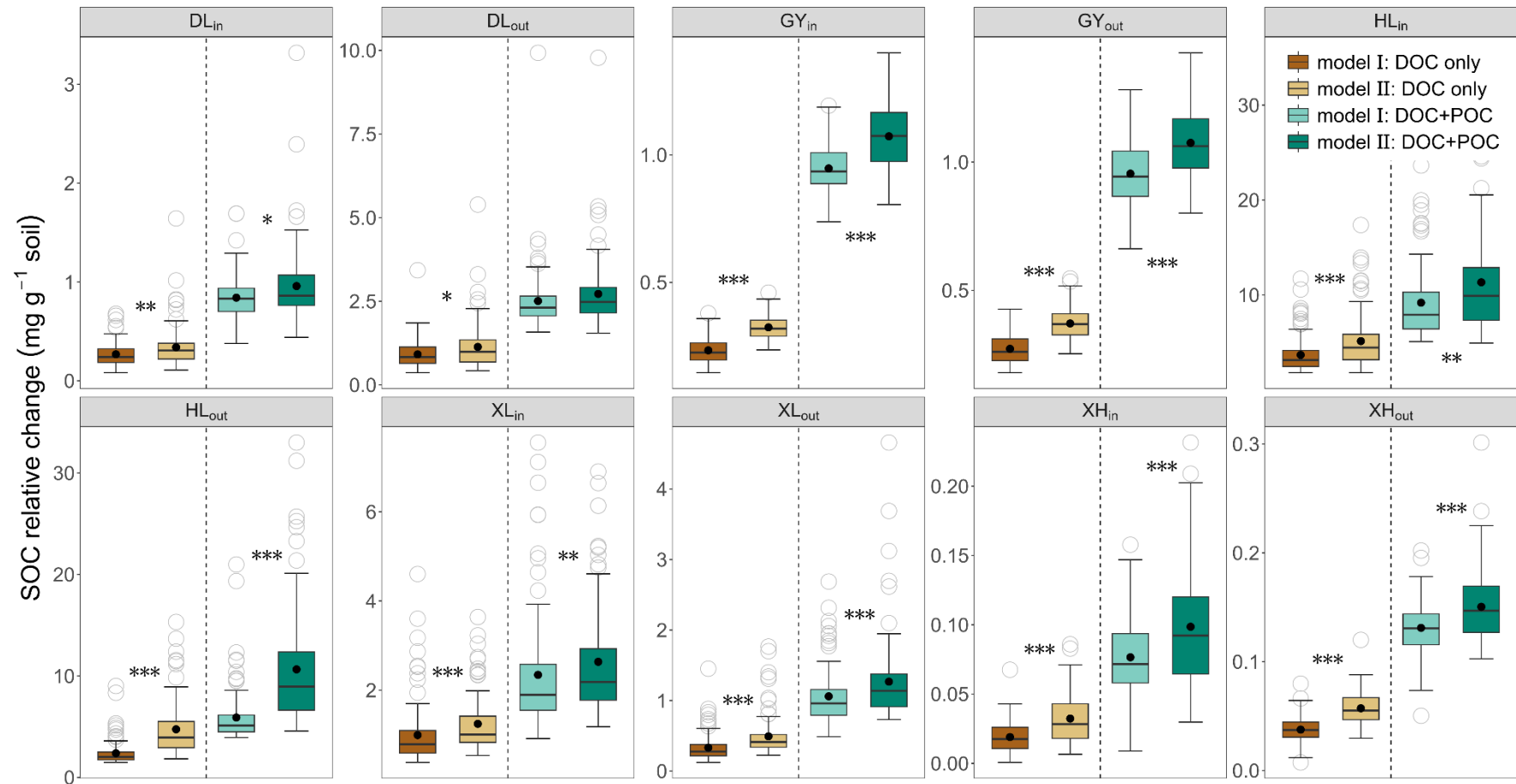
Figure S5. Relative changes in steady state at 20% C input increase under two types of C input conditions. The upper and lower ends of boxes denote the 0.25 and 0.75 percentiles, respectively. The solid line and solid dots in the box mark the median and mean of each dataset. Hollow dot denotes outliers.