Table S1 The parameters related to litter decomposition.

Litter carbon pools	f_{HR} [a]	R_{dec} (d^{-1}) [b]
Liable carbon	0.39	0.7
Unshielded cellulose	0.55	0.07
Lignin	0.29	0.014

[a] The fractions of heterotrophic respiration during the litter carbon decomposition. [b] The constant rate for the decomposition of litter carbon to soil carbon.

Table S2 Site information.

Site [a]	CBM	QYZ	DHM
Location	42°24′09″ N 128°05′45″ E	26°44′29″ N 115°03′29″ E	23°10′25″ N 112°32′04″ E
Elevation (m)	738	102	300
Stand age (years)	~200	37	~100
Canopy height (m)	27	12	17.5
LAI [b] $(m^2\ m^{-2})$	6.1	3.5	5.2
Soil type [c]	Montane dark brown forest soil/ Cambosols/ Cambisols	Red soil/ Ferrosols/ Acrisols	Lateritic red soil/ Ferrosols/ Acrisols, yellow soil/ Ferrosols/ Acrisols
SOC [d] $(g\ C\ kg^{-1})$	50.8	12.4	21.9
Soil pH [d]	5.0	4.7	3.8
Soil texture [d]	Silt loam	Silt loam	Silt loam
Clay [d] (<0.002 mm)	25%	15%	19%
Silt [d] (0.002−0.05 mm)	59%	68%	63%
Sand [d] (0.05−2.0 mm)	16%	17%	18%

[a] CBM, QYZ, and DHM are the abbreviations of the site name at the Changbai Mountains, QIanyanzhou and Dinghu Mountains, respectively.

[b] LAI is the abbreviation of leaf area index.

[c] Soil types follows the Chinese Genetic Soil Classification (1993)/ the Chinese Soil Taxonomy (1999)/ World Reference Base for Soil Resources (2014).

[d] Given soil properties are for the depth of 0−20 cm.

Table S3 Eco-physiological parameters used in modified CNMM-DNDC model for forests in different humid monsoon climate [a].

Code	Parameters (unit)	CBM [b] (Temperate)		QYZ [c] (Subtropics)	DHM [d] (South subtropics)	
p1	Forest type	DBT [b]	ENT [b]	ENT [c]	EBT [d]	ENT [d]
p2	Start Julian date of new growth	121	0	0	0	0
p3	End Julian date of litterfall	275	0	0	0	0
p4	Transfer growth period as fraction of growing season (dimensionless)	0.2	0.3	0.3	0.2	0.3
p5	Litterfall as fraction of growing season (dimensionless)	0.2	0.3	0.3	0.2	0.3
p6	Annual leaf and fine roots turnover fraction (yr^{-1})	1.0	0.15	0.35	0.5	0.32
p7	Annual live wood turnover fraction (yr^{-1})	0.7	0.7	0.7	0.7	0.7
p8	Annual plant mortality fraction (yr^{-1})	0.0213	0.009	0.005	0.005	0.005
p9	Annual fire mortality fraction (yr^{-1})	0.0	0.0	0.005	0.0	0.005
p10	New fine root C: new leaf C (DIM)	0.9	1.2	1.0	1.0	1.0
p11	New stem C: new leaf C (DIM)	2.4	1.4	2.2	1.6	2.2
p12	New live wood C: new total wood C (dimensionless)	0.1	0.379	0.1	0.22	0.1
p13	New coarse root C: new stem C (dimensionless)	0.23	0.29	0.3	0.3	0.3
p14	Daily allocation to current growth (dimensionless)	0.5	0.5	0.5	0.5	0.5
p15	C:N of leaves (dimensionless)	17.55	34.3	42	42	42
p16	C:N of leaf litter (dimensionless)	41.1	96.5	93	49	93
p17	C:N of fine roots (dimensionless)	47.4	56.4	42	42	42
p18	C:N of live wood (dimensionless)	97.05	97.4	50	50	50
p19	C:N of dead wood (dimensionless)	212	398	729	300	729
p20−22	Leaf litter labile: cellulose: lignin (dimensionless)	53:22:25	45:25:30	32:44:24	32:44:24	32:44:24
p23−25	Fine root labile: cellulose: lignin (dimensionless)	30:45:25	34:44:22	30:45:25	30:45:25	30:45:25

p26−27	Dead wood cellulose: lignin (dimensionless)	76:24	73:27	76:24	76:24	76:24
p28	Canopy light extinction coefficient (dimensionless)	0.58	0.5	0.5	0.7	0.5
p29	All-side to projected leaf area ratio (dimensionless)	2.0	2.6	2.6	2.0	2.6
p30	Canopy average specific leaf area (SLA) ($m^2\ kg^{-1}\ C$)	54.2	16.4	12.0	12.0	12.0
p31	Shaded SLA: sunlit SLA (dimensionless)	2.0	2.0	2.0	2.0	2.0
p32	Fraction of leaf N in Rubisco (dimensionless)	0.075	0.10	0.055	0.03	0.03
p33	Maximum stomatal conductance ($m\ s^{-1}$)	0.0065	0.006	0.003	0.005	0.003
p34	Cuticular conductance ($m\ s^{-1}$)	0.00001	0.00006	0.00001	0.00001	0000001
p35	Boundary layer conductance ($m\ s^{-1}$)	0.01	0.09	0.08	0.01	0.08
p36	Vapor pressure deficit: start of conductance reduction (Pa)	1100	610	930	1800	930
p37	Vapor pressure deficit: complete conductance reduction (Pa)	3600	3100	4100	4100	4100

[a] The parameters at the CBM, QYZ and DHM sites were cited from Li (2019), Li (2018) and Zeng et al. (2008).

[b] CBM, the Changbai Mountains site (in Jilin Province) with a mixed forest of the typical deciduous broad leaf trees (DBT) and the evergreen needle leaf trees (ENT) subjected to a humid temperate monsoon climate.

[c] QYZ, the Qianyanzhou site (in Jiangxi Province) with a mixed forest of the evergreen broad leaf trees (EBT) and the ENT subject to a humid southern subtropical monsoon climate.

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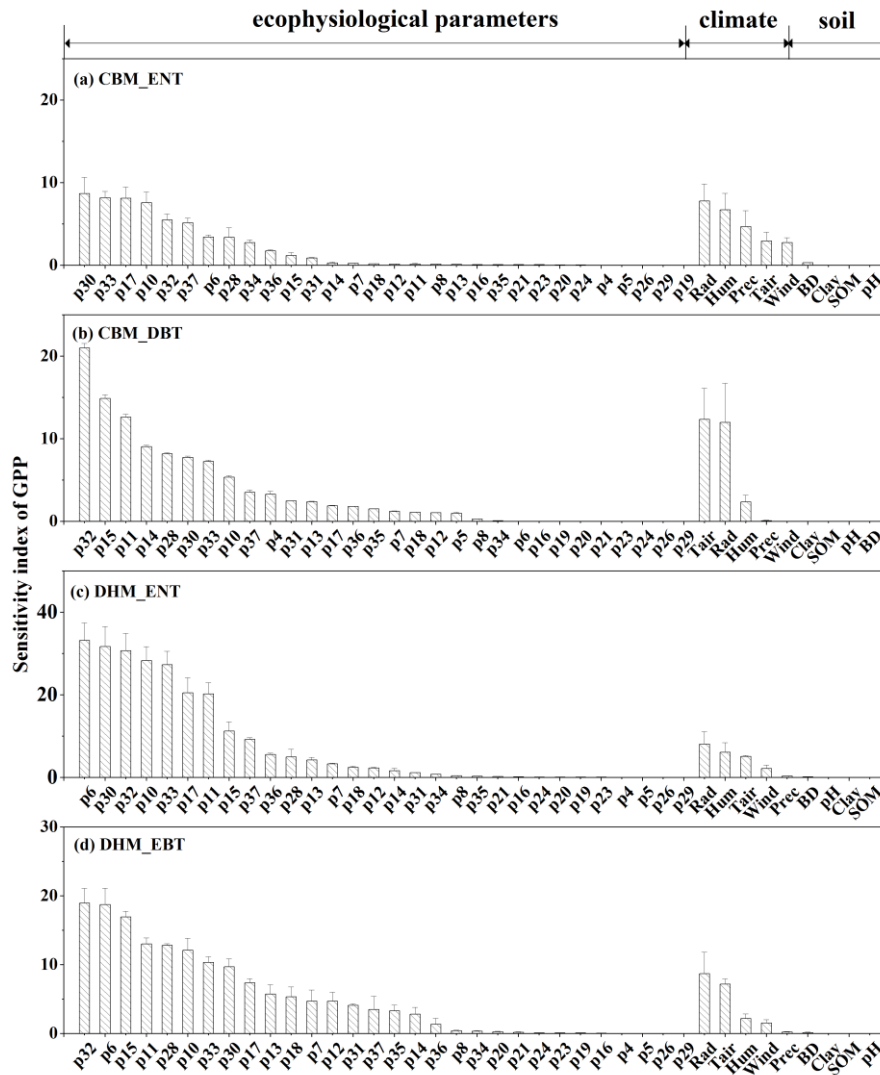
Figure: S1 Sensitivity indexes of modified CNMM-DNDC simulations on gross primary productivity (GPP) responding to alternations in individual eco-physiological parameters and model inputs of meteorological variables and soil properties for different tree types at CBM and DHM sites. An index is given as the mean (a wide bar) and standard deviation (an error bar) of three indexes, each resulted from the simulations for one year. The parameter name and value for each parameter are referred to Table S2. ENT, DBT and EBT are abbreviations of evergreen needle leaf trees, deciduous broad leaf trees, and evergreen broad leaf trees, respectively.
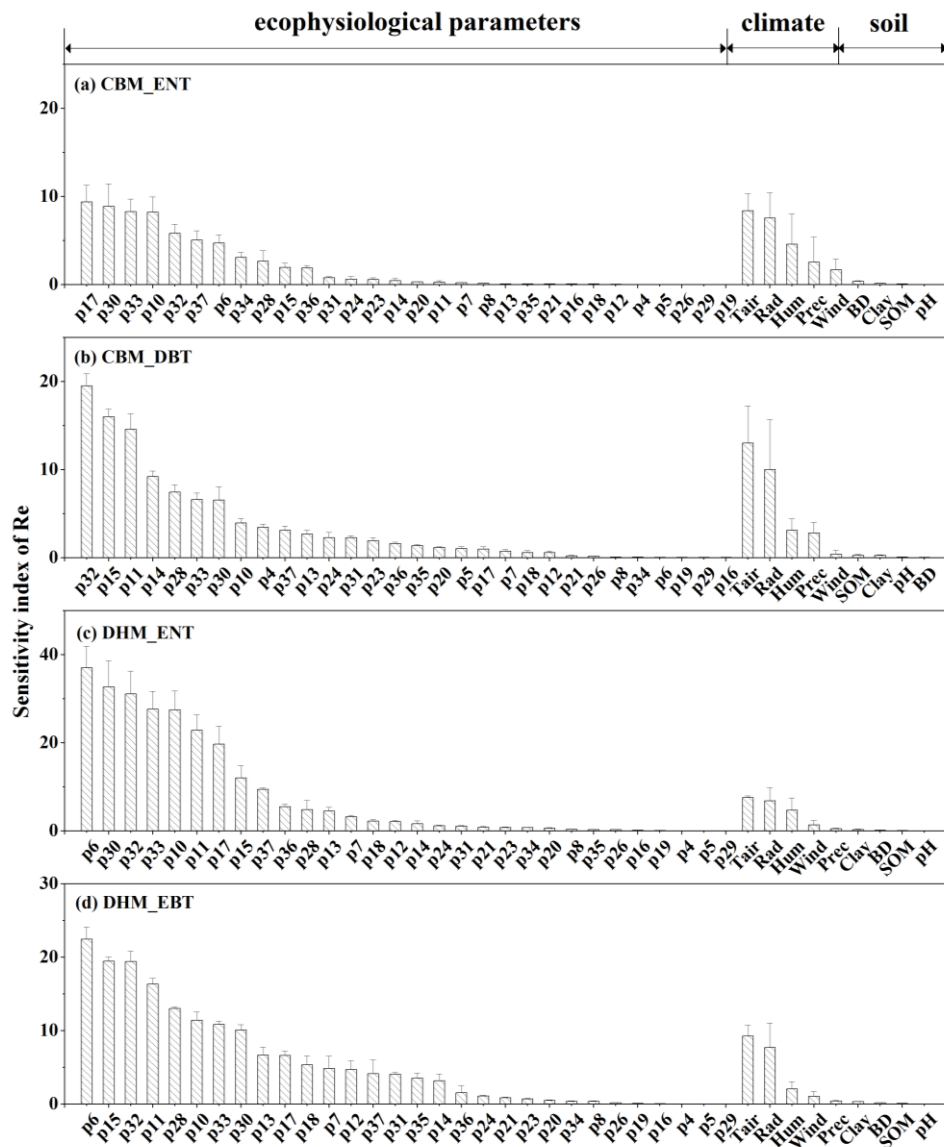
Figure: S2 Sensitivity indexes of modified CNMM-DNDC simulations on ecosystem respiration responding to alternations in individual eco-physiological parameters and model inputs of meteorological variables and soil properties for different tree types at CBM and DHM sites. An index is given as the mean (a wide bar) and standard deviation (an error bar) of three indexes, each resulted from the simulations for one year. The parameter name and value for each parameter are referred to Table S2. ENT, DBT and EBT are abbreviations of evergreen needle leaf trees, deciduous broad leaf trees, and evergreen broad leaf trees, respectively.