Supplementary material

Figure captions

Figure S1 Maps showing the distribution of the sample plots for the investigation of biomass carbon density for natural broad-leaved and coniferous forests in Shanxi, China. The number in parentheses denotes the number of the sample plots.

Figure S2 The exploratory structure equation models showing the geographical, climatic and stand factors that have direct and indirect effects on BCD (biomass carbon density) of natural broad-leaved and coniferous forests in Shanxi, China.

Figure S3 The good-fitting structure equation models showing the factors that have direct and indirect effects on biomass carbon density of broad-leaved (left) and coniferous (right) forests in Shanxi, China. LAT, latitude; ELE, elevation; TEMP, annual mean air temperature; PRCP, annual mean precipitation; AGE, stand age; COV, stand coverage; TYPE: forest types. Indicators for a good-fitting model are an insignificant χ^2 test statistic ($P > 0.05$; indicating that sample and observed covariance matrices are statistically indistinguishable), CFI > 0.95, and RMSEA < 0.08 (Grace et al., 2016; Hoyle, 2012). In the good-fitting model, solid arrows indicate significant paths ($P < 0.05$), while dashed arrows are non-significant paths. The numbers along the arrows are standardized regression weights indicating the effect size (black, significant; grey, non-significant).

Figure S4 Average biomass carbon density of different age intervals of natural broad-leaved and coniferous forests in Shanxi, China. The number in a solid circle denotes the number of sample plots for some age interval.

Figure S5 Average biomass carbon density of different age groups (left) and different age intervals (right) of natural broad-leaved and coniferous forests in Shanxi, China.

Figure S6 The plot showing the changes of different factors with the hot spots groups at different significant levels (right) of natural broad-leaved and coniferous forests in Shanxi, China. ELE: elevation, LAT: latitude, TEMP; temperature, PRCP: precipitation.

Table captions

Table S1 Direct, indirect, and total effects of stand age (AGE), stand coverage (COV), forest type (TYPE), elevation (ELE), latitude (LAT), mean annual temperature (TEMP) and precipitation (PRCP) on biomass carbon density for natural coniferous forests. ELE: elevation, LAT: latitude, TEMP; temperature, PRCP: precipitation; BCD: biomass carbon density.

Table S2 Same as Table S1 but for natural broad-leaved forests.

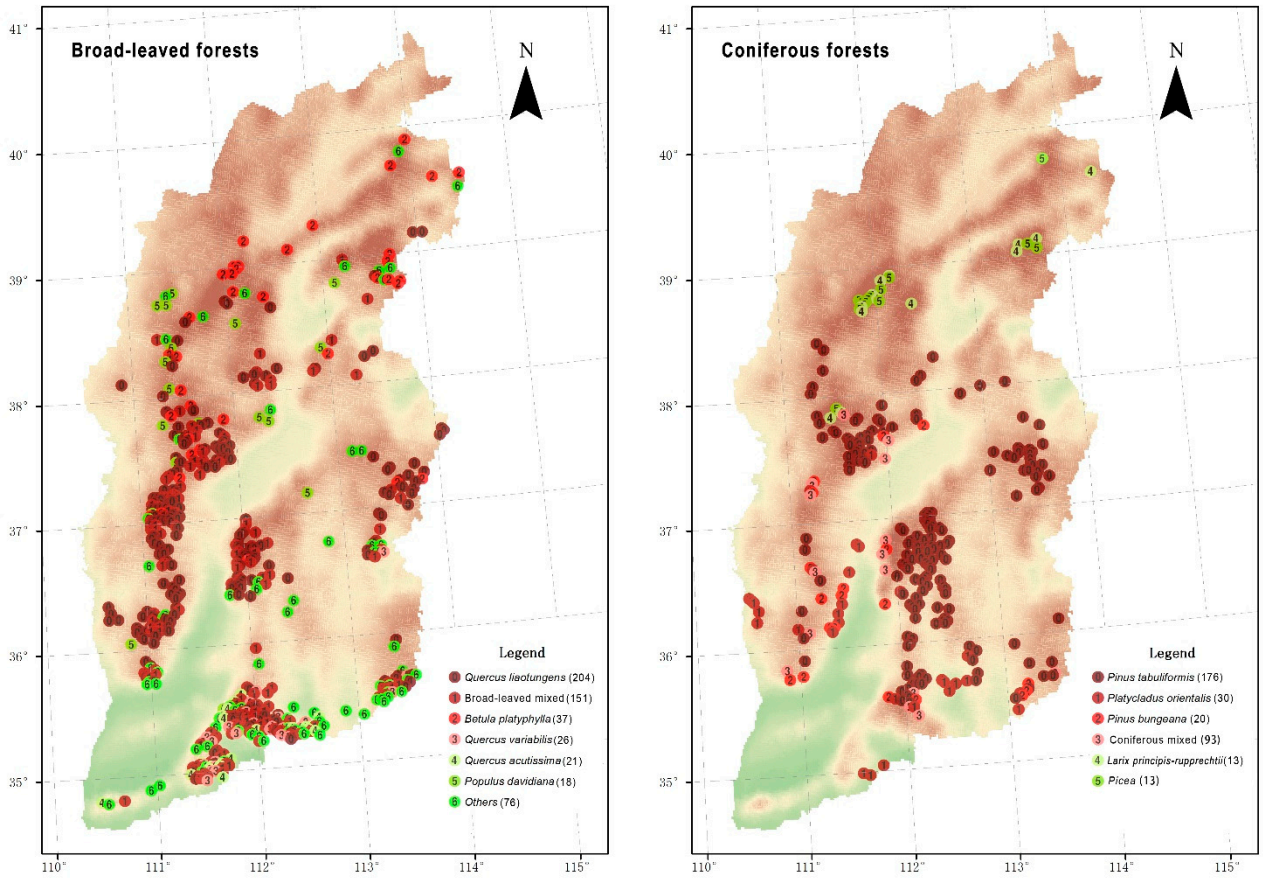

Figure S1 Maps showing the distribution of the sample plots for the investigation of biomass carbon density for natural broad-leaved and coniferous forests in Shanxi, China. The number in parentheses denotes the number of the sample plots.

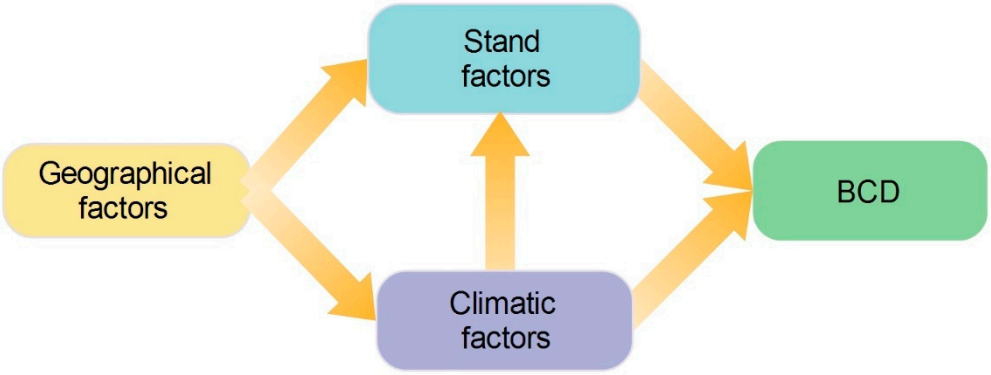

Figure S2 The exploratory structure equation models showing the geographical, climatic and stand factors that have direct and indirect effects on BCD (biomass carbon density) of natural broad-leaved and coniferous forests in Shanxi, China.

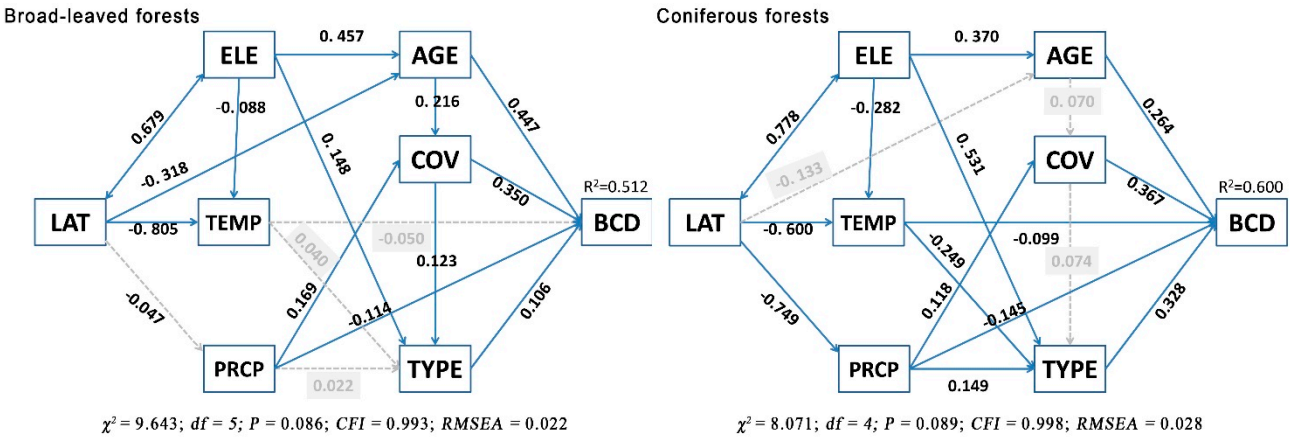

Figure S3 The good-fitting structure equation models showing the factors that have direct and indirect effects on biomass carbon density of broad-leaved (left) and coniferous (right) forests in Shanxi, China. LAT, latitude; ELE, elevation; TEMP, annual mean air temperature; PRCP, annual mean precipitation; AGE, stand age; COV, stand coverage; TYPE: forest types. Indicators for a good-fitting model are an insignificant χ^2 test statistic ($P > 0.05$; indicating that sample and observed covariance matrices are statistically indistinguishable), CFI > 0.95, and RMSEA < 0.08 (Grace et al., 2016; Hoyle, 2012). In the good-fitting model, solid arrows indicate significant paths ($P < 0.05$), while dashed arrows are non-significant paths. The numbers along the arrows are standardized regression weights indicating the effect size (black, significant; grey, non-significant).

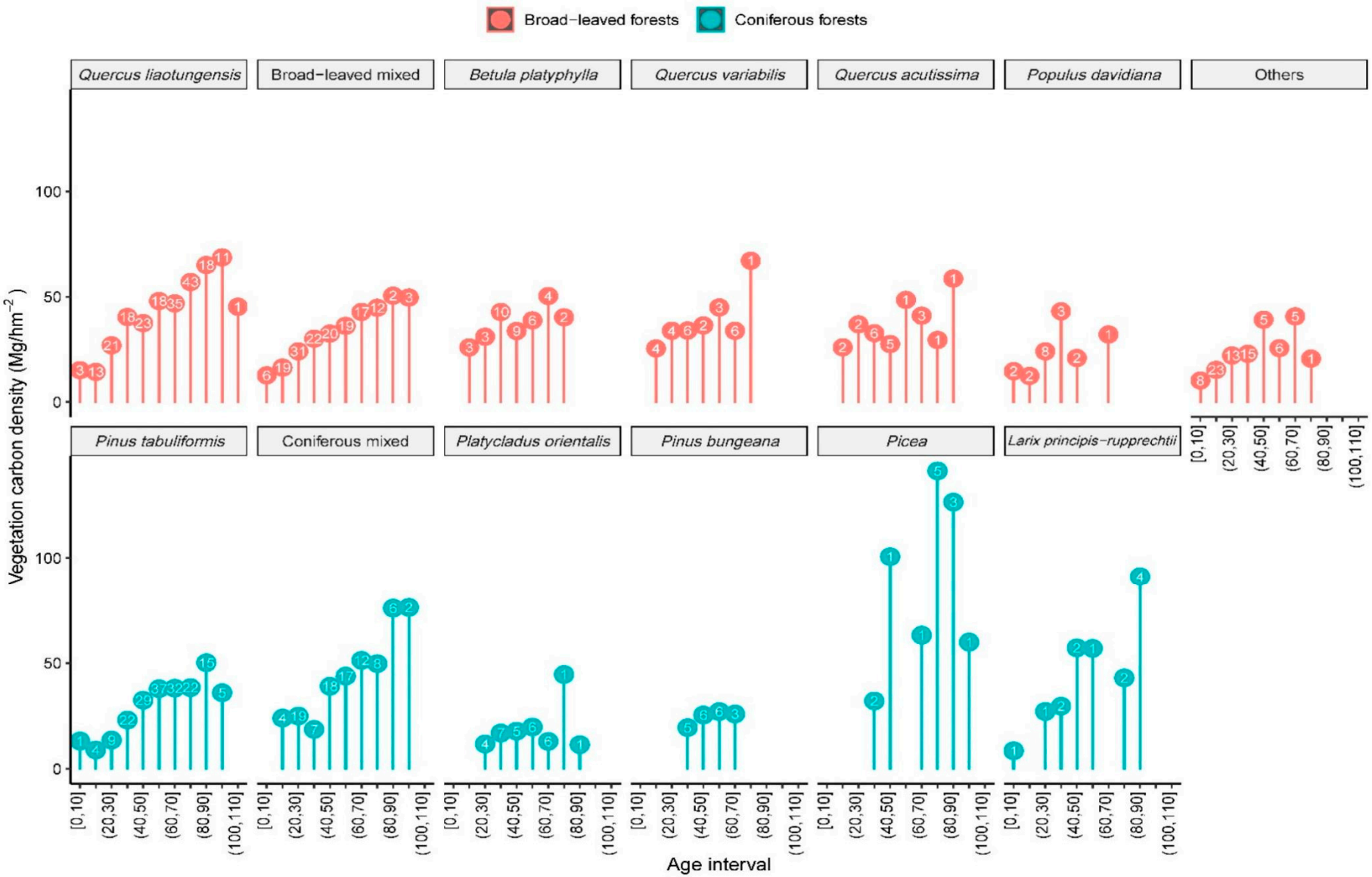

Figure S4 Average biomass carbon density of different age intervals of natural broad-leaved and coniferous forests in Shanxi, China. The number in a solid circle denotes the number of sample plots for some age interval.

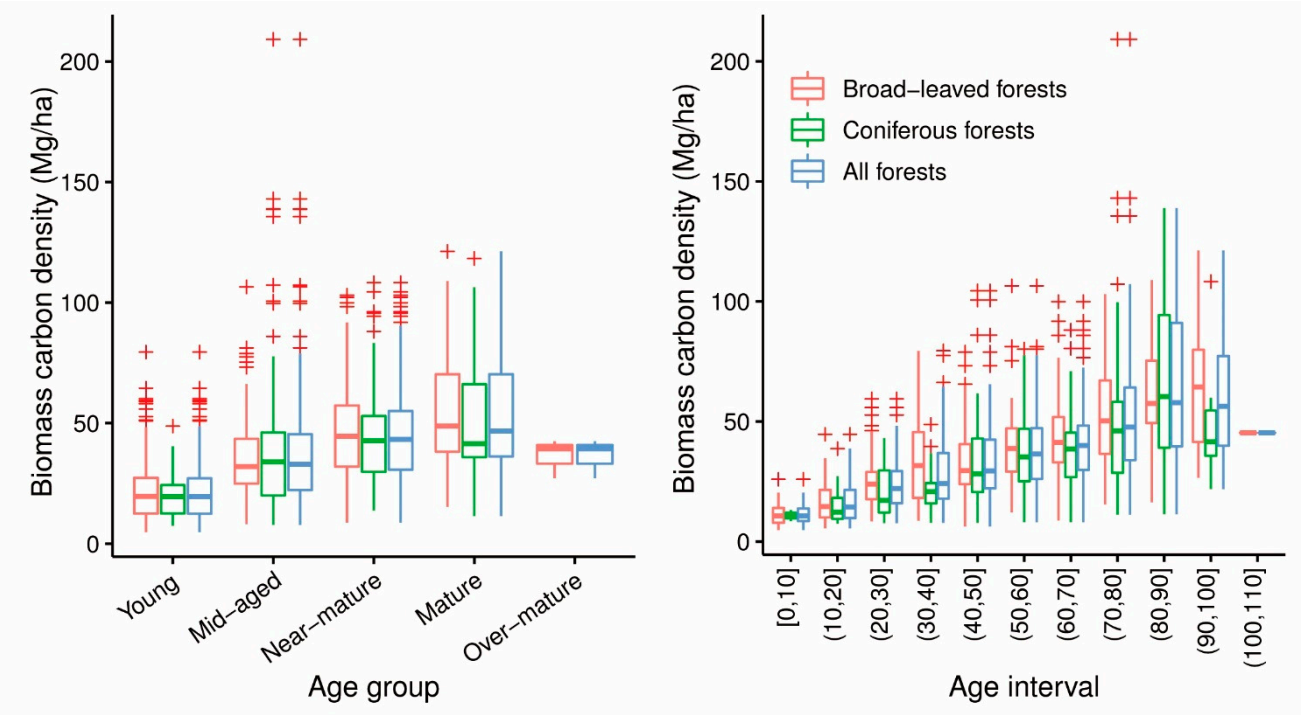

Figure S5 Average biomass carbon density of different age groups (left) and different age intervals (right) of natural broad-leaved and coniferous forests in Shanxi, China.

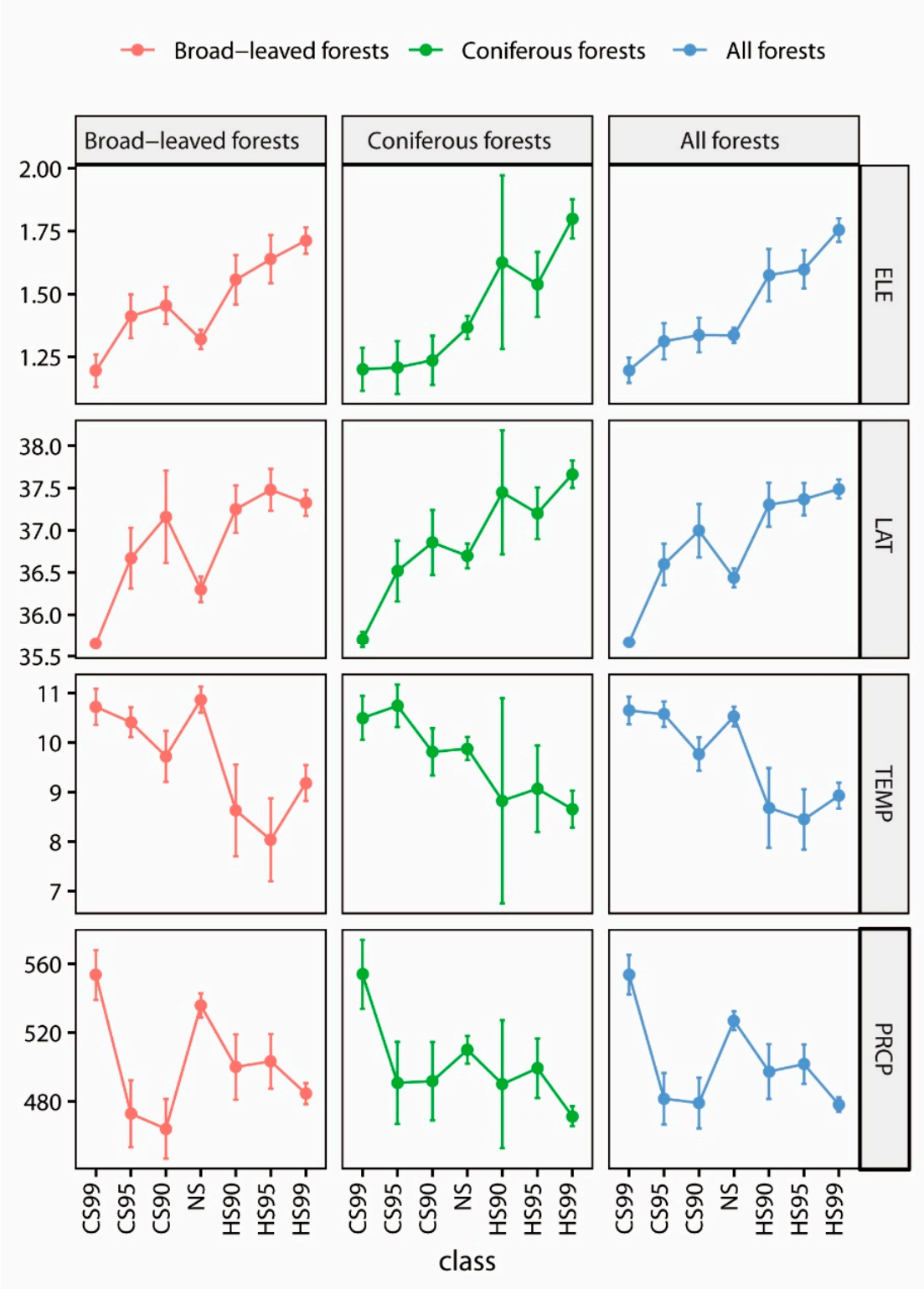

Figure S6 The plot showing the changes of different factors with the hot spots groups at different significant levels (right) of natural broad-leaved and coniferous forests in Shanxi, China. ELE: elevation, LAT: latitude, TEMP; temperature, PRCP: precipitation

Table S1 Direct, indirect, and total effects of stand age (AGE), stand coverage (COV), forest type (TYPE), elevation (ELE), latitude (LAT), mean annual temperature (TEMP) and precipitation (PRCP) on biomass carbon density for natural coniferous forests. ELE: elevation, LAT: latitude, TEMP; temperature, PRCP: precipitation; BCD: biomass carbon density.

Factor	Effect	Path (P)					Standardized Path Coefficient (SC)					Result
		P_1	P_2	P_3	P_4	P_5	SC_1	SC_2	SC_3	SC_4	SC_5	
LAT	Indirect	LAT TEMP	TEMP BCD	-	-	-	-0.544	0.000				0.000
	Indirect	LAT TEMP	TEMP TYPE	TYPE BCD	-	-	-0.544	-0.435	0.284			0.067
	Indirect	LAT ELE	ELE TEMP	TEMP BCD	-	-	0.466	-0.233	0.000			0.000
	Indirect	LAT ELE	ELE TEMP	TEMP TYPE	TYPE BCD	-	0.466	-0.233	-0.435	0.284		0.013
	Indirect	LAT ELE	ELE TYPE	TYPE BCD	-	-	0.466	0.608	0.284			0.080
	Indirect	LAT ELE	ELE AGE	AGE BCD			0.466	0.312	0.367			0.053
	Indirect	LAT ELE	ELE AGE	AGE COV	COV BCD		0.466	0.312	0.369	0.365		0.020
	Indirect	LAT ELE	ELE AGE	AGE COV	COV TYPE	TYPE BCD	0.466	0.312	0.369	0.117	0.284	0.002
	Indirect	LAT AGE	AGE BCD				0.000	0.367				0.000
	Indirect	LAT AGE	AGE COV	COV BCD			0.000	0.369	0.365			0.000
	Indirect	LAT AGE	AGE COV	COV TYPE	TYPE BCD		0.000	0.369	0.117	0.284		0.000
	Indirect	LAT PRCP	PRCP BCD				-0.854	-0.064				0.055
	Indirect	LAT PRCP	PRCP TYPE	TYPE BCD			-0.854	0.083	0.284			-0.020
	Indirect	LAT PRCP	PRCP COV	COV BCD			-0.854	0.299	0.365			-0.093
	Indirect	LAT PRCP	PRCP COV	COV TYPE	TYPE BCD		-0.854	0.299	0.117	0.284		-0.008
	Total											**0.169**
ELE	Indirect	ELE TEMP	TEMP BCD	-	-	-	-0.233	0.000				0.000
	Indirect	ELE TEMP	TEMP TYPE	TYPE BCD	-	-	-0.233	-0.435	0.284			0.029
	Indirect	ELE TYPE	TYPE BCD	-	-	-	0.608	0.284				0.173
	Indirect	ELE AGE	AGE BCD			-	0.312	0.367				0.115
	Indirect	ELE AGE	AGE COV	COV BCD		-	0.312	0.369	0.365			0.042
	Indirect	ELE AGE	AGE COV	COV TYPE	TYPE BCD	-	0.312	0.369	0.117	0.284		0.004
	Indirect	ELE LAT	LAT TEMP	TEMP BCD	-	-	0.466	-0.544	0.000			0.000
	Indirect	ELE LAT	LAT TEMP	TEMP TYPE	TYPE BCD	-	0.466	-0.544	-0.435	0.284		0.031
	Indirect	ELE LAT	LAT AGE	AGE BCD			0.466	0.000	0.367			0.000
	Indirect	ELE LAT	LAT AGE	AGE COV	COV BCD		0.466	0.000	0.369	0.365		0.000
	Indirect	ELE LAT	LAT AGE	AGE COV	COV TYPE	TYPE BCD	0.466	0.000	0.369	0.117	0.284	0.000
	Indirect	ELE LAT	LAT PRCP	PRCP BCD			0.466	0.854	-0.064			-0.025
	Indirect	ELE LAT	LAT PRCP	PRCP TYPE	TYPE BCD		0.466	0.854	0.083	0.284		0.009
	Indirect	ELE LAT	LAT PRCP	PRCP COV	COV BCD		0.466	0.854	0.299	0.365		0.043
	Indirect	ELE LAT	LAT PRCP	PRCP COV	COV TYPE	TYPE BCD	0.466	0.854	0.299	0.117	0.284	0.004
	Total											**0.424**
TEMP	Direct	TEMP BCD	-	-	-	-	0.000					0.000
	Indirect	TEMP TYPE	TYPE BCD		-	-	-0.435	0.284				-0.124
	Total											**-0.124**
PRCP	Direct	PRCP BCD			-	-	-0.064					-0.064
	Indirect	PRCP TYPE	TYPE BCD		-	-	0.083	0.284				0.024
	Indirect	PRCP COV	COV BCD		-	-	0.299	0.365				0.109
	Indirect	PRCP COV	COV TYPE	TYPE BCD			0.299	0.117	0.284			0.010
	Total											**0.079**
AGE	Direct	AGE BCD			-	-	0.367					0.367
	Indirect	AGE COV	COV BCD		-	-	0.369	0.365				0.135
	Indirect	AGE COV	COV TYPE	TYPE BCD			0.369	0.117	0.284			0.012
	Total											**0.514**
TYPE	Direct	TYPE BCD	-	-	-	-	0.284					0.284
	Total											**0.284**
COV	Direct	COV BCD	-	-	-	-	0.365					0.365
	Indirect	COV TYPE	TYPE BCD				0.117	0.284				0.033
	Total											**0.398**

Table S2 Same as Table S1 but for natural broad-leaved forests.

Factor	Effect	Path (P)					Standardized Path Coefficient (SC)					Result
		P_1	P_2	P_3	P_4	P_5	SC_1	SC_2	SC_3	SC_4	SC_5	
LAT	Indirect	LAT	TEMP BCD	-	-	-	-0.832	0.000				0.000
	Indirect	LAT	TEMP TYPE	TYPE BCD	-	-	-0.832	0.000	0.145			0.000
	Indirect	LAT ELE	ELE TEMP	TEMP BCD	-	-	0.386	-0.094	0.000			0.000
	Indirect	LAT ELE	ELE TEMP	TEMP TYPE	TYPE BCD	-	0.386	-0.094	0.000	0.145		0.000
	Indirect	LAT ELE	ELE TYPE	TYPE BCD	-	-	0.386	0.114	0.145			0.006
	Indirect	LAT ELE	ELE AGE	AGE BCD			0.386	0.495	0.367			0.070
	Indirect	LAT ELE	ELE AGE	AGE COV	COV BCD		0.386	0.495	0.369	0.365		0.026
	Indirect	LAT ELE	ELE AGE	AGE COV	COV TYPE	TYPE BCD	0.386	0.495	0.369	0.000	0.145	0.000
	Indirect	LAT AGE	AGE BCD				-0.318	0.367				-0.117
	Indirect	LAT AGE	AGE COV	COV BCD			-0.318	0.369	0.365			-0.043
	Indirect	LAT AGE	AGE COV	COV TYPE	TYPE BCD		-0.318	0.369	0.000	0.145		0.000
	Indirect	LAT PRCP	PRCP BCD				-0.699	-0.064				0.045
	Indirect	LAT PRCP	PRCP TYPE	TYPE BCD			-0.699	0.083	0.145			-0.008
	Indirect	LAT PRCP	PRCP COV	COV BCD			-0.699	0.299	0.365			-0.076
	Indirect	LAT PRCP	PRCP COV	COV TYPE	TYPE BCD		-0.699	0.299	0.000	0.145		0.000
	Total											**-0.097**
ELE	Indirect	ELE TEMP	TEMP BCD	-	-	-	-0.094	0.000				0.000
	Indirect	ELE TEMP	TEMP TYPE	TYPE BCD	-	-	-0.094	0.000	0.145			0.000
	Indirect	ELE TYPE	TYPE BCD	-	-	-	0.114	0.145				0.017
	Indirect	ELE AGE	AGE BCD			-	0.495	0.367				0.182
	Indirect	ELE AGE	AGE COV	COV BCD		-	0.495	0.369	0.365			0.067
	Indirect	ELE AGE	AGE COV	COV TYPE	TYPE BCD	-	0.495	0.369	0.000	0.145		0.000
	Indirect	ELE LAT	LAT TEMP	TEMP BCD	-	-	0.386	-0.832	0.000			0.000
	Indirect	ELE LAT	LAT TEMP	TEMP TYPE	TYPE BCD	-	0.386	-0.832	0.000	0.145		0.000
	Indirect	ELE LAT	LAT AGE	AGE BCD			0.386	-0.318	0.367			-0.045
	Indirect	ELE LAT	LAT AGE	AGE COV	COV BCD		0.386	-0.318	0.369	0.365		-0.017
	Indirect	ELE LAT	LAT AGE	AGE COV	COV TYPE	TYPE BCD	0.386	-0.318	0.369	0.000	0.145	0.000
	Indirect	ELE LAT	LAT PRCP	PRCP BCD			0.386	-0.699	-0.064			0.017
	Indirect	ELE LAT	LAT PRCP	PRCP TYPE	TYPE BCD		0.386	-0.699	0.083	0.145		-0.003
	Indirect	ELE LAT	LAT PRCP	PRCP COV	COV BCD		0.386	-0.699	0.299	0.365		-0.029
	Indirect	ELE LAT	LAT PRCP	PRCP COV	COV TYPE	TYPE BCD	0.386	-0.699	0.299	0.000	0.145	0.000
	Total											**0.188**
TEMP	Direct	TEMP BCD	-	-	-	-	0.000					0.000
	Indirect	TEMP TYPE	TYPE BCD		-	-	0.000	0.145				0.000
	Total											**0.000**
PRCP	Direct	PRCP BCD			-	-	-0.064					-0.064
	Indirect	PRCP TYPE	TYPE BCD		-	-	0.083	0.145				0.012
	Indirect	PRCP COV	COV BCD		-	-	0.299	0.365				0.109
	Indirect	PRCP COV	COV TYPE	TYPE BCD			0.299	0.000	0.145			0.000
	Total											**0.057**
AGE	Direct	AGE BCD			-	-	0.367					0.367
	Indirect	AGE COV	COV BCD		-	-	0.369	0.365				0.135
	Indirect	AGE COV	COV TYPE	TYPE BCD			0.369	0.000	0.145			0.000
	Total											**0.502**
TYPE	Direct	TYPE BCD	-	-	-	-	0.145					0.145
	Total											**0.145**
COV	Direct	COV BCD	-	-	-	-	0.365					0.365
	Indirect	COV TYPE	TYPE BCD				0.000	0.145				0.000
	Total											**0.365**