Supplementary Materials

Table S1-1 Chronology metadata in the north-south transition zone of China

Site	Lon	Lat	Species	Ele	Trees	Cores	MS	FY	MLS	Method
QG	103.3	34	*Pinus t*	2346	29	56	334	2014	160.1	FSS
KES	103.3	34.6	*Pinus t*	2796	33	63	409	2022	212.7	FSS
DLG	103.3	33.8	*Pinus t*	2363	25	43	352	2014	192.1	FSS
SZY	103.4	34	*Pinus t*	2259	22	44	225	2021	155.4	FSS
GJSY	103.4	33.8	*Pinus t*	2288	20	41	359	2021	202	FSS
MGY	103.8	33.9	*Pinus t*	2340	22	44	189	2021	133	FSS
LZK	103.8	34.1	*Pinus t*	2261	25	49	191	2014	136.3	FSS
RLY	103.9	33.4	*Pinus t*	2512	20	41	302	2021	176.2	FSS
BLY	103.9	33.5	*Pinus t*	2257	28	56	185	2021	147.4	FSS
JZY	104	33.6	*Pinus t*	2574	23	46	409	2021	214.7	FSS
MNK	104	33.6	*Pinus t*	2654	24	49	382	2022	227.9	FSS
ST	104.2	33.6	*Pinus t*	1990	20	41	230	2014	156.3	FSS
BYS	104.3	33.3	*Pinus t*	2140	23	54	123	2022	53	67%
GQS	104.4	34.6	*Pinus t*	2383	21	42	464	2022	175.4	FSS
SMS	106.1	34.4	*Pinus t*	1200	33	82	407	2022	133.8	FSS
MBH	106.4	32.6	*Pinus t*	1139	20	36	200	2018	77.4	FSS
BJY	106.9	34.1	*Pinus t*	1585	24	54	287	2022	93.9	FSS
HG	108.3	33.5	*Pinus t*	1655	36	71	194	2018	147.8	FSS
CZP	108.4	33.8	*Pinus t*	1324	40	80	324	2018	106.4	FSS
SBS	108.5	33.4	*Pinus t*	1483	53	75	254	2021	117.7	FSS
BLP	108.5	33.8	*Pinus t*	1300	21	42	89	2022	51.1	FSS
ZYG	108.5	34	*Pinus t*	635	10	20	27	2022	20.6	NEC
HPS	108.6	32.6	*Pinus t*	625	20	37	46	2018	28.4	FSS
S1T	108.6	33.4	*Pinus t*	1050	16	32	147	2018	106.5	FSS
GYS	108.8	33.9	*Pinus t*	1730	21	40	400	2022	146.9	FSS
NWT	108.9	33.9	*Pinus t*	1560	48	101	228	2022	136	FSS
WHS	108.8	33.9	*Pinus t*	1950	24	50	293	2022	134.7	FSS
SLY	110.1	33.4	*Pinus t*	1057	10	24	246	2022	170.5	FSS
YJL	110.2	34.2	*Pinus t*	1046	19	39	46	2021	32.4	FSS
DLS	110.7	33.7	*Pinus t*	1499	24	43	83	2018	63.3	FSS
LJL	111.8	33.6	*Pinus t*	1805	26	46	211	2022	115.1	FSS
QLB	112.2	33.7	*Pinus t*	1726	20	40	255	2022	172.2	FSS
YSB	105.8	33.5	*Pinus b*	1222	7	13	153	2021	96.1	FSS

DS	105.9	33.7	*Pinus b*	1205	37	69	352	2021	234.9	FSS
XSC	106	33.6	*Pinus b*	1227	23	46	252	2021	74.1	FSS
JYW	106.1	33.6	*Pinus b*	1244	21	42	222	2021	104.3	FSS
LGX	106.3	33.9	*Pinus b*	1163	26	57	238	2021	94.8	FSS
YPS	106.4	33.6	*Pinus b*	1997	17	36	112	2020	64.8	FSS
LFGZ	106.6	33.8	*Pinus b*	1385	45	91	402	2022	123.2	FSS
WZB	107.8	32.9	*Pinus b*	802	21	53	326	2018	150.6	FSS
HPC	109.7	32.8	*Pinus b*	800	20	48	211	2020	58.5	FSS
WXS	110.3	34.3	*Pinus b*	1174	24	43	279	2018	126.7	FSS
HLB	111.4	34	*Pinus b*	908	23	45	301	2022	172.8	FSS
SYB	111	32.2	*Pinus b*	767	5	11	288	2023	150.9	FSS
YYC	109.5	31.9	*Pinus m*	1040	23	45	69	2018	53	FSS
ZZS	110.1	32.5	*Pinus m*	909	21	43	209	2022	139.4	FSS
HLS	110.2	33	*Pinus m*	710	20	40	45	2022	39.8	FSS
SHS	114	31.8	*Pinus m*	722	17	34	57	2022	40.1	FSS
JGS	114.6	29.4	*Pinus m*	910	21	42	132	2022	85.1	FSS
XDS	114.8	31.6	*Pinus m*	556	20	40	51	2022	40.8	FSS
DBS	115	31.5	*Pinus m*	415	6	15	205	2022	164.6	FSS
MC1	115.1	31.3	*Pinus m*	482	20	40	165	2022	118.2	FSS
MC2	115.1	31.3	*Pinus m*	646	19	38	148	2022	95.2	FSS
TTZ	115.7	31.1	*Pinus m*	1332	18	40	174	2022	111.2	FSS
QTG	115.7	31.1	*Pinus h*	816	20	40	148	2022	118.9	FSS
BMJ	116.1	31.1	*Pinus h*	1710	26	50	213	2022	148.9	FSS
XYS	117.6	30.2	*Pinus h*	1025	20	35	117	2017	120.6	FSS
QLF	118.9	30.1	*Pinus h*	1025	21	31	175	2017	113.5	FSS
TMX	119.3	30.3	*Pinus h*	1100	21	21	337	2015	162.4	FSS
TMD	119.5	30.3	*Pinus h*	950	11	11	190	2015	158.9	FSS
HSS	110	34.4	*Pinus a*	2050	136	277	654	2012	328.3	FSS
TZS	110	33.3	*Pinus a*	1814	23	45	95	2018	71.3	FSS
LP	106.6	32.7	*Pinus he*	1586	21	46	183	2018	142.3	FSS
HPB	108.2	32.6	*Pinus he*	1443	17	34	112	2018	88.3	FSS
JGY	104.4	34.6	*Picea p*	2383	18	44	394	2022	200.9	FSS
BJS	108.6	33.8	*Larix p*	2689	27	63	260	2022	150.7	FSS
CLL	109.8	34.2	*Abies c*	2555	20	41	202	2012	106.6	FSS
SBG	108.8	32	*Picea b*	2205	19	40	157	2021	115.4	FSS
TJYS	109.1	31.9	*Keteleeria*	805	43	95	489	2023	210.2	FSS
SNJ	110.1	31.4	*Abies f*	2349	38	72	198	2022	112.4	FSS

Notes: Longitude - Lon, Latitude - Lat, *Pinus t - Pinus tabuliformis*, *Pinus b - Pinus bungeana*,

Pinus m - Pinus massoniana, *Pinus h - Pinus hwangshanensis*, *Pinus a - Pinus armandii*, *Pinus he - Pinus henryi*, *Picea p - Picea purpurea*, *Larix p - Larix potaninii*, *Abies c - Abies chensiensis*, *Picea b - Picea breweriana*, *Keteleeria - Keteleeria davidiana*, *Abies f - Abies fargesii*, Master series - MS, Final year - FY, Mean length of series - MLS, Friedman super smoother - FSS, 67% of total series length spline - 67%, Negative exponential curve (k>0)-NEC. Bold sample names indicate that the data comes from ITRDB.

Table S1-2 Tree-ring sampling site information in the north-south transition zone of China

Number	Site	Lon	Lat	Species	Ele	Trees	Cores	Final C
1	QG	103.3	34.0	*Pinus t*	2346	29	56	QG
2	KES	103.3	34.6	*Pinus t*	2796	16	37	KES
3	KRQ	103.3	34.6	*Pinus t*	2610	17	26	
4	DLG	103.3	33.8	*Pinus t*	2363	25	43	DLG
5	SZY	103.4	34.0	*Pinus t*	2259	22	44	SZY
6	GJSY	103.4	33.8	*Pinus t*	2288	20	41	GJSY
7	MGY	103.8	33.9	*Pinus t*	2340	22	44	MGY
8	LZK	103.8	34.1	*Pinus t*	2261	25	49	LZK
9	RLY	103.9	33.4	*Pinus t*	2512	20	41	RLY
10	BLY	103.9	33.5	*Pinus t*	2257	28	56	BLY
11	JZY	104.0	33.6	*Pinus t*	2574	23	46	JZY
12	MNK	104.0	33.6	*Pinus t*	2654	24	49	MNK
13	ST	104.2	33.6	*Pinus t*	1990	20	41	ST
14	BYS	104.3	33.3	*Pinus a*	2165	13	30	BYS
15	BYY	104.3	33.3	*Pinus t*	2115	10	24	
16	JGS	104.4	34.6	*Pinus t*	2383	21	42	GQS
17	YSB	105.8	33.5	*Pinus b*	1222	7	13	YSB
18	DS	105.9	33.7	*Pinus b*	1205	37	69	DS
19	XSC	106.0	33.6	*Pinus b*	1227	23	46	XSC
20	SMS1	106.1	34.4	*Pinus t*	1200	20	53	SMS
21	SMS2	106.1	34.4	*Pinus t*	1200	13	29	
22	JYW	106.1	33.6	*Pinus b*	1244	21	42	JYW
23	LGX	106.3	33.9	*Pinus b*	1163	26	57	LGX
24	MBH	106.4	32.6	*Pinus t*	1139	20	36	MBH
25	YPS	106.4	33.6	*Pinus b*	1997	17	36	YPS
26	FYC	106.6	33.9	*Pinus b*	1760	2	5	LFGZ

27	LFGZ	106.6	33.8	*Pinus b*	1246	28	56	
28	JPC	106.6	33.8	*Pinus b*	1150	12	24	
29	LFG	106.6	33.8	*Pinus b*	1110	1	2	
30	HBS	106.6	33.8	*Pinus b*	1104	2	4	
31	LP	106.6	32.7	*Pinus he*	1586	21	46	LP
32	SBY	106.9	34.1	*Pinus t*	1450	15	31	BJY
33	SBC	106.9	34.1	*Pinus t*	1470	1	4	
34	SHC	107.1	34.1	*Pinus t*	1755	2	6	
35	JPG	107.1	33.8	*Pinus t*	1550	3	6	
36	HQC	107.7	34.8	*Pinus t*	1336	3	7	
37	WZB	107.8	32.9	*Pinus b*	802	21	53	WZB
38	HPB	108.2	32.6	*Pinus he*	1443	17	34	HPB
39	HG	108.3	33.5	*Pinus t*	1655	36	71	HG
40	CZP	108.4	33.8	*Pinus t*	1324	40	80	CZP
41	SBS	108.4	33.3	*Pinus t*	1584	36	40	SBS
42	SBH	108.4	33.3	*Pinus t*	1584	16	33	
43	HGJ	108.6	33.7	*Pinus t*	1282	1	2	
44	BLP	108.5	33.8	*Pinus t*	1300	21	42	BLP
45	ZYG	108.5	34.0	*Pinus t*	635	10	20	ZYG
46	HPS	108.6	32.6	*Pinus t*	625	20	37	HPS
47	S1T	108.6	33.4	*Pinus t*	1050	16	32	S1T
48	GYS	108.8	33.9	*Pinus t*	1730	21	40	GYS
49	WHS	108.8	33.9	*Pinus t*	1950	24	50	WHS
50	NWT1	108.9	33.9	*Pinus t*	1560	21	42	NWT
51	NWT2	108.9	33.9	*Pinus t*	1560	27	59	
52	XPS	109.4	33.5	*Pinus b*	663	4	8	HPC
53	HPC	109.7	32.8	*Pinus b*	800	16	40	
54	DZG	110.4	33.3	*Pinus t*	990	2	4	SLY
55	YZC	109.5	33.2	*Pinus t*	1210	2	5	
56	MG	110.2	33.1	*Pinus t*	731	2	4	
57	NSC	110.1	34.0	*Pinus t*	1050	2	6	
58	WYX	110.4	33.3	*Pinus t*	1299	2	5	
59	YJL	110.2	34.2	*Pinus t*	1046	19	39	YJL
60	YYC	109.5	31.9	*Pinus m*	1040	23	45	YYC
61	HSS	110.0	34.4	*Pinus a*	2050	136	277	HSS
62	DLS	110.7	33.7	*Pinus t*	1499	24	43	DLS
63	WXS	110.3	34.3	*Pinus b*	1174	24	43	WXS
64	TZS	110.0	33.3	*Pinus a*	1814	23	45	TZS

65	TQX	110.3	33.3	*Pinus b*	915	2	8	HLB
66	MJG	110.7	34.1	*Pinus b*	1124	7	7	
67	HSY	111.2	33.9	*Pinus b*	1244	2	4	
68	WSB	111.2	33.9	*Pinus b*	1245	1	2	
69	MCB	111.2	34.0	*Pinus b*	1052	1	3	
70	YJF	111.9	34.6	*Pinus b*	442	1	2	
71	BQC	111.8	34.3	*Pinus b*	560	1	3	
72	DJF	111.4	34.2	*Pinus b*	670	1	1	
73	LGB	111.4	34.4	*Pinus b*	704	2	4	
74	XGC	111.4	34.0	*Pinus b*	970	1	2	
75	ZYG	111.5	33.8	*Pinus b*	1167	1	2	
76	ZKC	111.5	33.8	*Pinus b*	1181	1	2	
77	ZWC	111.8	34.1	*Pinus b*	582	1	2	
78	BSC	112.0	33.6	*Pinus b*	858	1	3	
79	QLB	112.2	33.7	*Pinus t*	1726	20	40	QLB
80	LJL	111.7	33.6	*Pinus t*	1805	11	19	LJL
81	BYS	111.8	33.6	*Pinus t*	1975	15	27	
82	HLS	110.2	33.0	*Pinus m*	710	20	40	HLS
83	ZZS	110.1	32.5	*Pinus m*	909	21	43	ZZS
84	LTK	110.9	32.1	*Pinus b*	663	3	6	SYB
85	BJS	111.1	32.3	*Pinus b*	871	2	5	
86	JGS	114.0	31.8	*Pinus m*	722	17	34	SHS
87	XDS	114.8	31.6	*Pinus m*	556	20	40	XDS
88	TPX	115.0	31.5	*Pinus m*	351	2	4	DBS
89	ZHX	115.0	31.6	*Pinus m*	448	2	4	
90	WGS	115.0	31.5	*Pinus m*	448	2	7	
91	MC1	115.1	31.3	*Pinus m*	482	20	40	MC1
92	MC2	115.1	31.3	*Pinus m*	646	19	38	MC2
93	QTG	115.7	31.1	*Pinus h*	816	20	40	QTG
94	TTZ	115.7	31.1	*Pinus m*	1332	18	40	TTZ
95	BMJ	116.1	31.1	*Pinus h*	1710	26	50	BMJ
96	JGS	114.6	29.4	*Pinus m*	910	21	42	JGS
97	XYS	117.6	30.2	*Pinus h*	1025	20	35	XYS
98	QLF	118.9	30.1	*Pinus h*	1025	21	31	QLF
99	TMX	119.3	30.3	*Pinus h*	1100	21	21	TMX
100	TMD	119.5	30.3	*Pinus h*	950	11	11	TMD
101	FY	108.2	32.6	*Keteleeria*	659	2	3	TJYS
102	FXY	107.8	32.2	*Keteleeria*	1065	2	4	

103	BLT	107.8	32.2	*Keteleeria*	658	1	2	
104	DYB	107.8	32.3	*Keteleeria*	648	1	2	
105	YJL	107.7	32.3	*Keteleeria*	955	1	2	
106	WJP	107.8	32.3	*Keteleeria*	1011	1	3	
107	SJH	107.8	32.3	*Keteleeria*	792	1	2	
108	SLM	107.7	32.4	*Keteleeria*	865	2	4	
109	XFZ	107.8	32.4	*Keteleeria*	656	1	1	
110	BGC	107.7	32.5	*Keteleeria*	1088	1	2	
111	SPC	109.4	31.8	*Keteleeria*	1060	1	1	
112	HWC	109.4	32.1	*Keteleeria*	883	1	2	
113	LTK	109.5	32.1	*Keteleeria*	726	3	6	
114	LLZ	109.3	32.2	*Keteleeria*	622	1	2	
115	SSL	110.0	31.9	*Keteleeria*	677	9	30	
116	MJD	109.9	32.2	*Keteleeria*	706	3	6	
117	JDX	110.1	31.6	*Keteleeria*	592	3	6	
118	SST	110.0	31.9	*Keteleeria*	660	1	2	
119	FXS	109.6	31.8	*Keteleeria*	796	3	6	
120	GQS	110.5	31.1	*Keteleeria*	759	2	4	
121	YSS	110.6	31.2	*Keteleeria*	582	1	2	
122	HLD	110.8	31.2	*Keteleeria*	899	1	2	
123	DLP	111.0	31.2	*Keteleeria*	831	1	1	
124	JGY	104.4	34.6	*Picea p*	2383	18	44	JGY
125	BJS	108.6	33.8	*Larix p*	2689	27	63	BJS
126	CLL	109.8	34.2	*Abies c*	2555	20	41	CLL
127	SBG	108.8	32.0	*Picea b*	2205	19	40	SBG
128	SNJ	110.1	31.4	*Abies f*	2349	38	72	SNJ

Notes: Longitude - Lon, Latitude - Lat, *Pinus t - Pinus tabuliformis*, *Pinus b - Pinus bungeana*, *Pinus m - Pinus massoniana*, *Pinus h - Pinus hwangshanensis*, *Pinus a - Pinus armandii*, *Pinus he - Pinus henryi*, *Picea p - Picea purpurea*, *Larix p - Larix potaninii*, *Abies c - Abies chensiensis*, *Picea b - Picea breweriana*, *Keteleeria - Keteleeria davidiana*, *Abies f - Abies fargesii*, Final C- Final chronology .

Table S2 Different statistical values of tree-ring width index chronologies from 70 sampling sites in the north-south transition zone

Site	AR1a	AR1b	MI	SD	MS	VFE	SNR	EPS	EPS ≥ 0.85

QG	0.263	0.212	0.975	0.256	0.268	0.397	25.457	0.962	1681
KES	0.264	0.441	0.984	0.249	0.218	0.326	21.917	0.956	1614
DLG	0.226	0.258	0.964	0.313	0.298	0.415	21.794	0.956	1770
SZY	0.103	0.205	0.990	0.356	0.380	0.551	42.089	0.977	1797
GJSY	0.095	0.217	0.988	0.155	0.157	0.543	39.505	0.975	1663
MGY	0.170	0.147	0.981	0.211	0.228	0.482	24.001	0.960	1833
LZK	0.500	0.385	0.983	0.206	0.188	0.391	18.881	0.950	1824
RLY	0.302	0.345	0.981	0.216	0.208	0.641	59.184	0.983	1720
BLY	0.083	0.128	0.986	0.186	0.204	0.525	46.240	0.979	1837
JZY	0.400	0.451	0.980	0.205	0.178	0.536	43.532	0.978	1613
MNK	0.288	0.458	0.982	0.221	0.199	0.393	26.073	0.963	1641
ST	0.636	0.510	0.967	0.168	0.135	0.197	7.615	0.884	1785
BYS	0.225	0.318	0.980	0.251	0.241	0.504	9.401	0.904	1900
GQS	-0.102	0.195	0.973	0.237	0.256	0.542	30.666	0.968	1559
SMS	0.001	0.064	0.983	0.212	0.239	0.508	32.462	0.970	1745
MBH	0.434	0.451	0.981	0.184	0.165	0.374	2.428	0.708	1895
BJY	0.055	0.194	0.981	0.152	0.137	0.290	6.063	0.858	1890
HG	0.330	0.415	0.980	0.224	0.201	0.340	24.318	0.961	1825
CZP	0.302	0.305	0.987	0.317	0.249	0.251	15.128	0.938	1800
SBS	0.229	0.316	0.980	0.175	0.156	0.245	16.003	0.941	1768
BLP	-0.041	0.078	0.991	0.190	0.211	0.513	3.031	0.752	1934
ZYG	0.074	0.154	0.941	0.281	0.355	0.558	7.045	0.876	1996
HPS	0.177	0.190	0.985	0.127	0.134	0.307	9.898	0.908	1973
S1T	0.385	0.400	0.983	0.133	0.114	0.293	9.055	0.901	1872
GYS	0.104	0.399	1.007	0.267	0.227	0.375	15.344	0.939	1623
NWT	0.070	0.328	0.983	0.164	0.152	0.292	29.972	0.968	1795
WHS	0.011	0.046	0.939	0.211	0.263	0.427	25.850	0.963	1865
SLY	0.099	0.230	0.980	0.168	0.172	0.315	7.352	0.880	1855
YJL	0.031	0.031	0.969	0.193	0.218	0.413	11.927	0.923	1976
DLS	0.311	0.077	0.980	0.226	0.229	0.372	1.656	0.623	1936
LJL	0.165	0.297	0.981	0.173	0.170	0.455	29.582	0.967	1812
QLB	0.132	0.207	0.983	0.204	0.206	0.514	34.622	0.972	1768
YSB	0.106	0.146	0.993	0.201	0.201	0.674	11.829	0.922	1869
DS	0.272	0.240	0.975	0.209	0.216	0.357	33.585	0.971	1670
XSC	0.064	0.028	0.983	0.196	0.187	0.366	5.528	0.847	1930
JYW	-0.083	-0.053	1.005	0.282	0.288	0.363	15.936	0.941	1910
LGX	-0.187	0.055	0.980	0.260	0.275	0.514	30.449	0.968	1784
YPS	0.276	0.313	0.982	0.158	0.150	0.484	8.902	0.899	1909

LFGZ	0.265	0.306	0.979	0.238	0.220	0.423	34.672	0.972	1830
WZB	0.232	0.193	0.986	0.294	0.317	0.451	27.161	0.964	1693
HPC	0.306	0.384	1.000	0.205	0.182	0.401	4.183	0.807	1810
WXS	0.343	0.393	0.981	0.257	0.240	0.314	12.689	0.927	1740
HLB	-0.002	0.171	0.977	0.215	0.233	0.239	10.233	0.911	1722
SYB	0.214	0.342	0.981	0.177	0.155	0.401	3.554	0.780	1736
YYC	0.457	0.347	0.969	0.174	0.145	0.208	8.336	0.893	1950
ZZS	0.217	0.312	0.978	0.227	0.230	0.495	28.282	0.966	1814
HLS	-0.054	-0.055	0.979	0.203	0.216	0.318	12.546	0.926	1978
SHS	0.200	0.169	0.989	0.155	0.168	0.416	14.146	0.934	1966
JGS	0.306	0.445	0.993	0.210	0.174	0.316	12.959	0.928	1891
XDS	0.099	0.062	1.000	0.238	0.271	0.352	16.586	0.943	1972
DBS	0.326	0.389	0.967	0.288	0.283	0.413	8.334	0.893	1818
MC1	0.352	0.388	0.982	0.299	0.299	0.428	26.040	0.963	1858
MC2	0.381	0.415	0.972	0.217	0.200	0.353	14.903	0.937	1875
TTZ	0.445	0.421	0.976	0.201	0.184	0.376	16.148	0.942	1849
QTG	0.319	0.358	0.992	0.177	0.150	0.380	20.242	0.953	1875
BMJ	0.562	0.587	0.976	0.194	0.144	0.311	18.591	0.949	1810
XYS	0.597	0.566	0.975	0.230	0.179	0.495	30.640	0.968	1901
QLF	0.434	0.435	0.977	0.220	0.191	0.465	24.252	0.960	1843
TMX	0.479	0.473	0.973	0.292	0.238	0.436	13.786	0.932	1855
TMD	0.549	0.479	0.988	0.225	0.188	0.574	10.800	0.915	1826
HSS	-0.019	0.140	0.983	0.213	0.213	0.418	75.047	0.987	1510
TZS	0.321	0.261	0.984	0.203	0.188	0.301	11.563	0.920	1924
LP	0.457	0.532	0.985	0.185	0.145	0.302	17.336	0.945	1836
HPB	0.444	0.391	0.982	0.161	0.139	0.274	8.624	0.896	1907
JGY	0.300	0.546	0.978	0.237	0.187	0.420	24.605	0.961	1629
BJS	0.364	0.343	0.979	0.227	0.203	0.507	48.388	0.980	1763
CLL	0.513	0.492	0.975	0.181	0.155	0.362	15.679	0.940	1895
SBG	0.527	0.387	0.981	0.162	0.145	0.562	38.774	0.975	1865
TJYS	0.245	0.138	0.966	0.185	0.209	0.308	28.661	0.966	1535
SNJ	0.546	0.522	0.985	0.150	0.120	0.334	28.431	0.966	1825

Notes: Autoregressive model of order 1 – AR1a (from 1950), AutoRegressive model of order 1 – AR1b (from EPS ≥ 0.85 cutoff year), Mean tree-ring width index – MI, Standard deviation – SD, Mean sensitivity – MS, Variance in first eigenvector (%) – VFE, Signal-to-noise ratio – SNR, Expressed population signal – EPS.

Table S3 Information about the 24 GCM models provided by CMIP6

Model	Full name	Source	Resolution
ACCESS-CM2	Australian Community Climate and Earth-System Simulator - Coupled Model version 2	Australia	250 km
ACCESS-ESM1-5	Australian Community Climate and Earth-System Simulator Earth System Model version 1.5	Australia	250 km
BCC-CSM2-MR	Beijing Climate Center Climate System Model version 2 - Medium Resolution	China	100 km
CanESM5	Canadian Earth System Model version 5	Canada	100 km
CAS-ESM2-0	Chinese Academy of Sciences Earth System Model version 2	China	100 km
CESM2-WACCM	Community Earth System Model version 2 - Whole Atmosphere Community Climate Model	America	100 km
CMCC-CM2-SR5	CMCC Climate Model version 2 - Standard Resolution 5	Italy	100 km
CMCC-ESM2	CMCC Earth System Model version 2	Italy	100 km
EC-Earth3	European Consortium Earth System Model, version 3	Europe	80 km
EC-Earth3-Veg	European Consortium Earth System Model, version 3 - Vegetation	Europe	80 km
EC-Earth3-Veg-LR	European Consortium Earth System Model, version 3 - Vegetation - Low Resolution	Europe	100 km
FGOALSf3-L	Flexible Global Ocean-Atmosphere-Land System model	China	100 km
FGOALS-g3	Flexible Global Ocean-Atmosphere-Land System model, Grid-point version 3	China	100 km
GFDL-ESM4	Geophysical Fluid Dynamics Laboratory Earth System Model version 4	America	100 km
INM-CM4-8	Institute of Numerical Mathematics Climate Model version 4.8	Russia	150 km
INM-CM5-0	Institute of Numerical Mathematics Climate Model version 5.0	Russia	150 km

IPSL-CM6A-LR	Institut Pierre-Simon Laplace Climate Model version 6 - Low Resolution	Europe	150 km
KACE-1-0-G	Korea Advanced Climate Ecosystem Model version 1.0-G	Korea	100 km
MCM-UA-1-0	Malmö University Climate Model version UA 1.0	Sweden	100 km
MIROC6	Model for Interdisciplinary Research on Climate version 6	Japan	140 km
MPI-ESM1-2-HR	Max Planck Institute Earth System Model version 1.2 - High Resolution	Germany	25 km
MPI-ESM1-2-LR	Max Planck Institute Earth System Model version 1.2 - Low Resolution	Germany	100 km
MRI-ESM2-0	Meteorological Research Institute Earth System Model version 2.0	Japan	100 km
NorESM2-LM	Norwegian Earth System Model version 2	Norway	100 km

Table S4 Redundancy analysis results for three different growth response relationships

Growth response relationship	Drivers	Variance	Contribution	F	Pr(>F)	Sig
Temperature-growth relationship	Longitude	0.044797	0.235288	12.6919	0.001	***
	Latitude	0.014263	0.074914	4.0409	0.002	**
	Pinus bungeana	0.013227	0.069472	3.7475	0.002	**
	Pinus tabuliformis	0.010987	0.057707	3.1128	0.004	**
	De Martonne aridity index	0.009432	0.049540	2.6723	0.007	**
	Elevation	0.008978	0.047155	2.5437	0.009	**
	Pinus armandi	0.008319	0.043694	2.3570	0.029	*
	Mean length of series	0.008187	0.043001	2.3196	0.018	*
	Climate water deficit	0.008033	0.042192	2.2759	0.017	*
	Temperature	0.007376	0.038741	2.0897	0.026	*
	Pinus hwangshanensis	0.007172	0.037670	2.0320	0.044	*
	UNEP-aridity index	0.006032	0.031682	1.7089	0.071	
	Picea purpurea	0.005932	0.031157	1.6806	0.104	
	Abies chensiensis	0.005232	0.027480	1.4824	0.117	
	Larix potaninii	0.004963	0.026067	1.4062	0.150	
	Pinus henryi	0.004739	0.024891	1.3427	0.192	

	Keteleeria davidiana	0.004483	0.023546	1.2701	0.229	
	Soil moisture	0.004064	0.021345	1.1515	0.310	
	Precipitation	0.003841	0.020174	1.0883	0.346	
	Vapor pressure deficit	0.003758	0.019738	1.0647	0.370	
	Pinus massoniana	0.003550	0.018646	1.0059	0.420	
	Abies fargesii	0.003027	0.015899	0.8576	0.499	
Precipitation-growth relationship	Longitude	0.034137	0.171544	8.0600	0.001	***
	De Martonne aridity index	0.018400	0.092463	4.3443	0.001	***
	Latitude	0.017487	0.087875	4.1288	0.001	***
	Elevation	0.009294	0.046704	2.1945	0.009	**
	Pinus henryi	0.008814	0.044292	2.0811	0.018	*
	Temperature	0.008468	0.042553	1.9994	0.022	*
	Climate water deficit	0.008368	0.042050	1.9757	0.033	*
	Mean length of series	0.007908	0.039739	1.8671	0.042	*
	Picea purpurea	0.007490	0.037638	1.7685	0.054	
	Pinus bungeana	0.007429	0.037332	1.7541	0.045	*
	Pinus tabuliformis	0.007178	0.036071	1.6947	0.057	
	UNEP-aridity index	0.007062	0.035488	1.6674	0.048	*
	Soil moisture	0.006746	0.033900	1.5928	0.068	
	Larix potaninii	0.006534	0.032834	1.5429	0.077	
	Pinus hwangshanensis	0.006371	0.032015	1.5042	0.085	
	Keteleeria davidiana	0.006042	0.030362	1.4267	0.131	
	Vapor pressure deficit	0.006016	0.030231	1.4204	0.141	
	Precipitation	0.005888	0.029588	1.3902	0.150	
	Pinus massoniana	0.005633	0.028307	1.3301	0.178	
	Pinus armandi	0.005592	0.028101	1.3203	0.176	
	Abies chensiensis	0.004896	0.024603	1.1561	0.293	
	Abies fargesii	0.003246	0.016312	0.7665	0.703	
scPDSI-growth relationship	Longitude	0.155881	0.444953	26.3369	0.001	***
	De Martonne aridity index	0.024624	0.070288	4.1603	0.025	*
	Precipitation	0.020827	0.059449	3.5188	0.035	*
	Mean length of series	0.018895	0.053935	3.1924	0.048	*
	Latitude	0.017573	0.050161	2.9690	0.074	
	Elevation	0.012556	0.035840	2.1213	0.117	
	Abies fargesii	0.010641	0.030374	1.7979	0.156	
	Picea purpurea	0.009714	0.027728	1.6413	0.179	
	Pinus bungeana	0.009571	0.027320	1.6172	0.147	
	Temperature	0.008960	0.025576	1.5138	0.211	

	Larix potaninii	0.008440	0.024092	1.4260	0.195	
	Climate water deficit	0.007613	0.021731	1.2863	0.263	
	Pinus henryi	0.007118	0.020318	1.2026	0.258	
	Abies chensiensis	0.006940	0.019810	1.1725	0.279	
	Vapor pressure deficit	0.006789	0.019379	1.1470	0.284	
	Pinus massoniana	0.005341	0.015246	0.9024	0.377	
	UNEP-aridity index	0.004992	0.014249	0.8435	0.432	
	Keteleeria davidiana	0.004423	0.012625	0.7473	0.466	
	Soil moisture	0.003824	0.010915	0.6461	0.465	
	Pinus tabuliformis	0.003200	0.009134	0.5406	0.574	
	Pinus armandi	0.001858	0.005304	0.3139	0.802	
	Pinus hwangshanensis	0.000551	0.001573	0.0931	0.996	

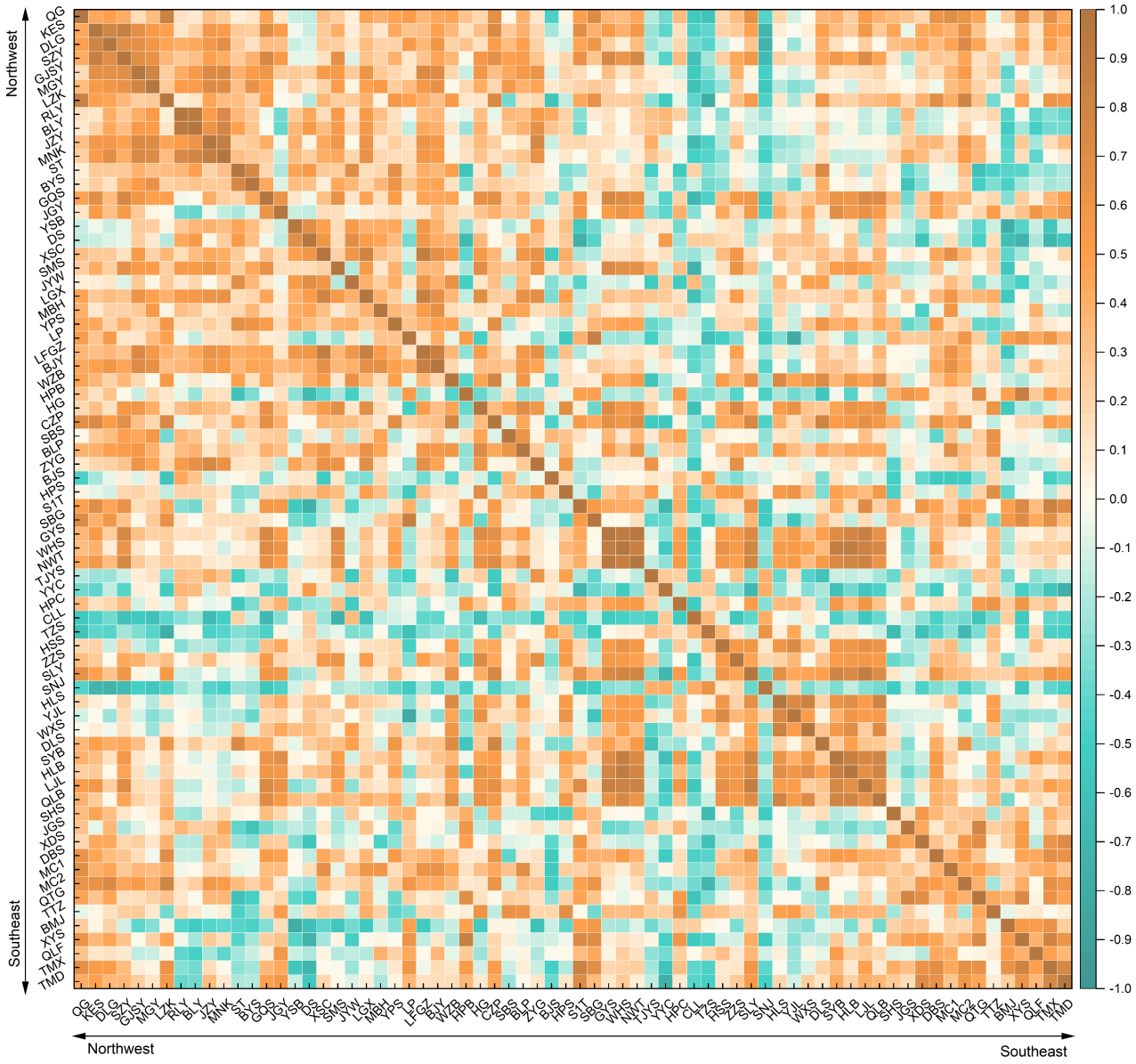

Figure S1 Pearson correlation between 70 tree-ring width chronologies in the north-south transition zone of China (NSTZ). The calculation period is within the respective coverage range from 1950 to 2022. The horizontal and vertical axis labels are the sampling site names, and they have been sorted from northwest to southeast.

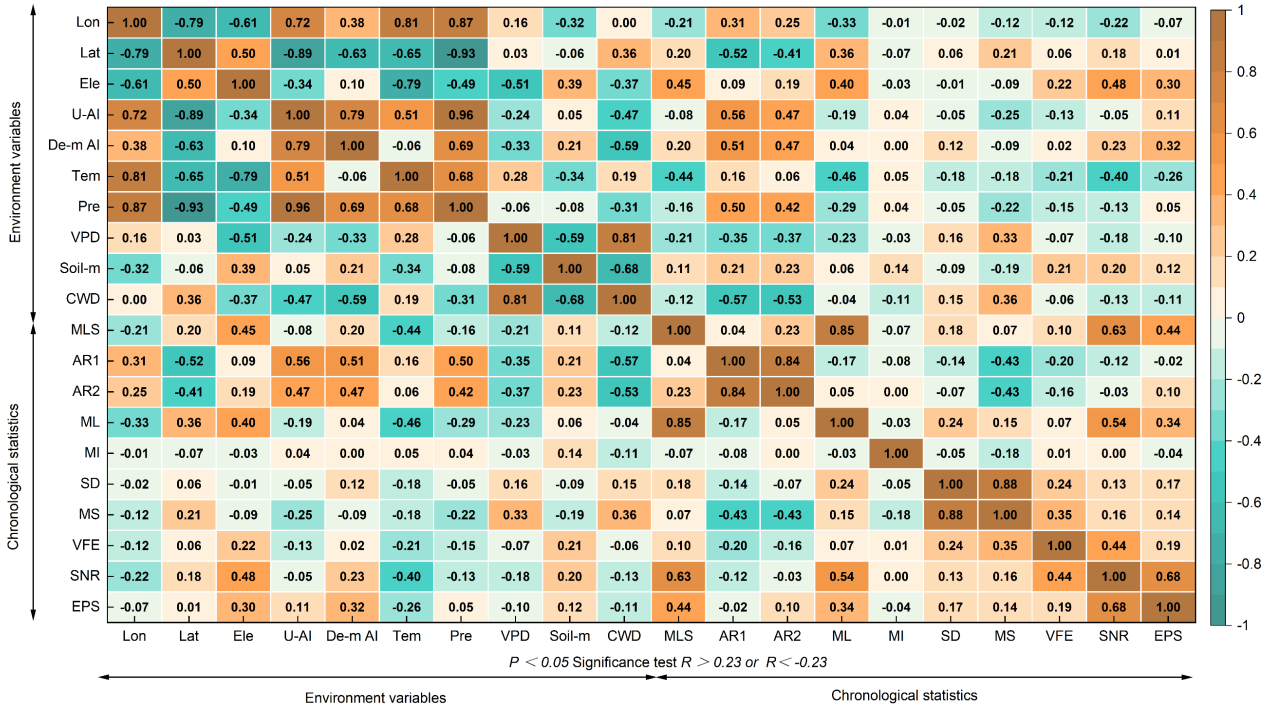

Figure S2 Pearson correlation between environmental variables and chronological statistics at 70 sampling points in the north-south transition zone of China (NSTZ). The full abbreviations of the horizontal and vertical axis labels are as follows: Lon: Longitude, Lat: Latitude, Ele: Elevation, U-AI: UNEP-aridity index, De M-AI: De Martonne aridity index, Tem: Temperature, Pre: Precipitation, VPD: Vapor pressure deficit, Soil-m: Soil moisture, CWD: Climate water deficit, MLS: Mean length of series, AR1: AutoRegressive model of order 1 (1950 – 2022), AR2: AutoRegressive model of order 1 (EPS ≥ 0.85 cutoff year), MI: Mean tree-ring width index, SD: Standard deviation, MS: Mean sensitivity, VFE: Variance in first eigenvector (%), SNR: Signal-to-noise ratio, EPS: Expressed population signal.

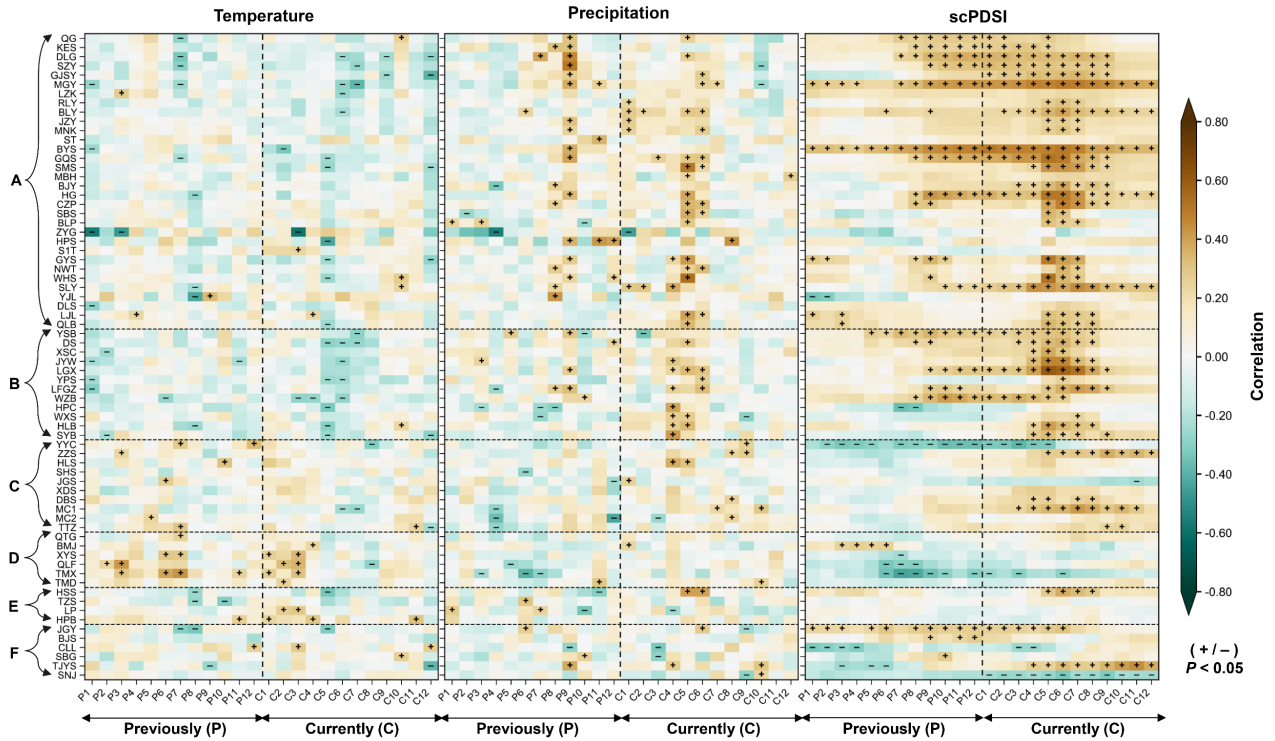

Figure S3 Pearson correlation analysis of the tree ring width index (TRW) and the main climate factors (temperature, precipitation, drought index) at 70 stations in the north-south transition zone of China (NSTZ). The left axis represents the sampling sites distribution, which has been sorted by tree species type and sorted by northwest-southeast direction see Figure 2; the lower axis represents the monthly distribution, from January of the previous year (P) to December of the current year (C), a total of 24 months, with black dotted lines used for intervals; the symbol + indicates a significant positive correlation, and the symbol – indicates a significant negative correlation. The tree species classification is as follows: A: *Pinus tabuliformis*, B: *Pinus bungeana*, C: *Pinus massoniana*, D: *Pinus hwangshanensis*, E: *Pinus armandii* and *Pinus henryi*, F: *Picea purpurea* (JGY) *Larix potaninii* (BJS) *Abies chensiensis* (CLL) *Picea breweriana* (SBG) *Keteleeria davidiana* (TJYS) *Abies fargesii* (SNJ)

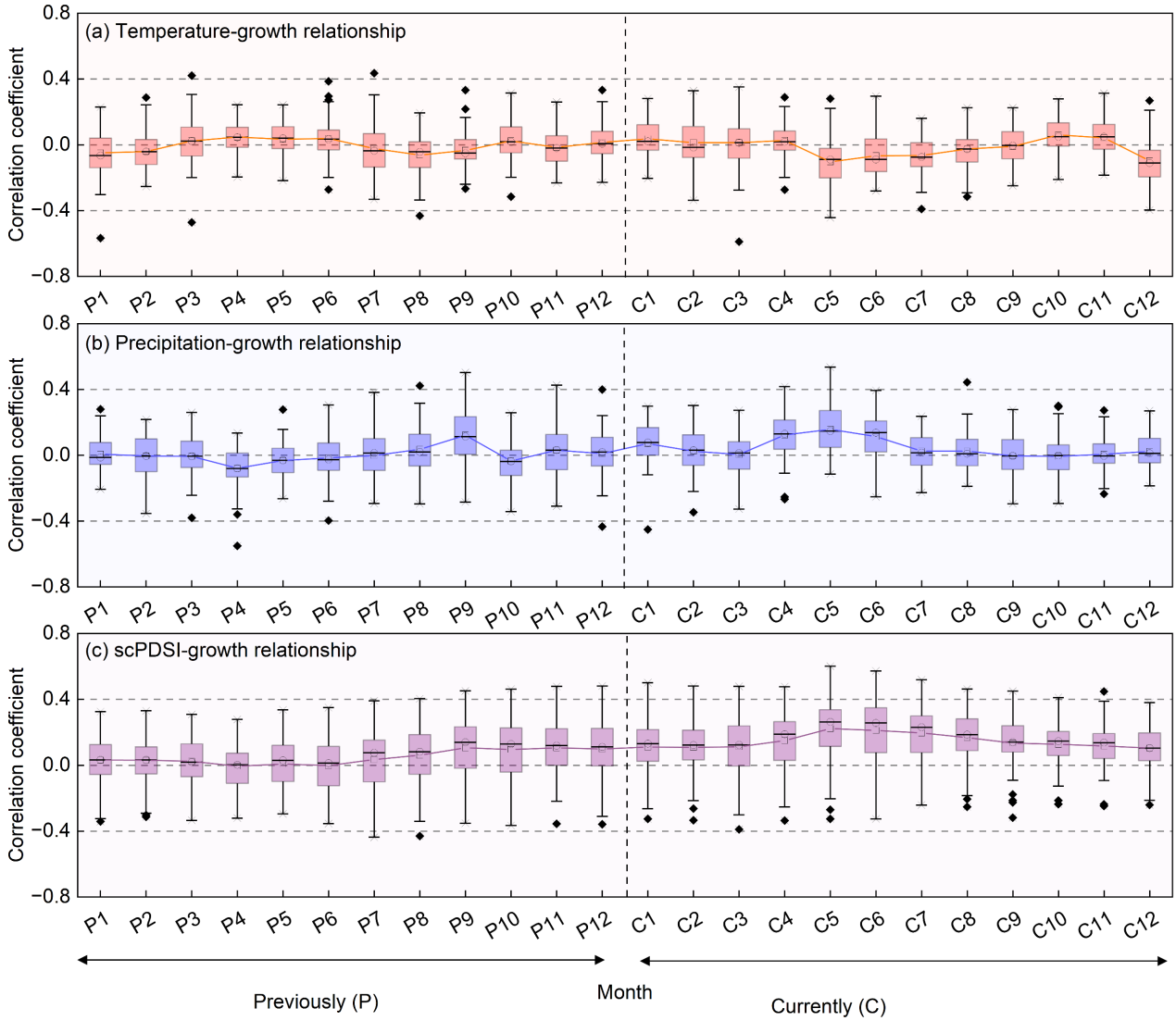

Figure S4 Boxplot distributions of the three main growth response relationships at 70 sampling sites across the north-south transition zone of China over 24 different months: (a) temperature-growth relationship, (b) precipitation-growth relationship, and (c) drought-growth relationship. The boxes represent the interquartile range (25% to 75%), the whiskers indicate the 1% to 99% range, and the lines connect the monthly mean values.

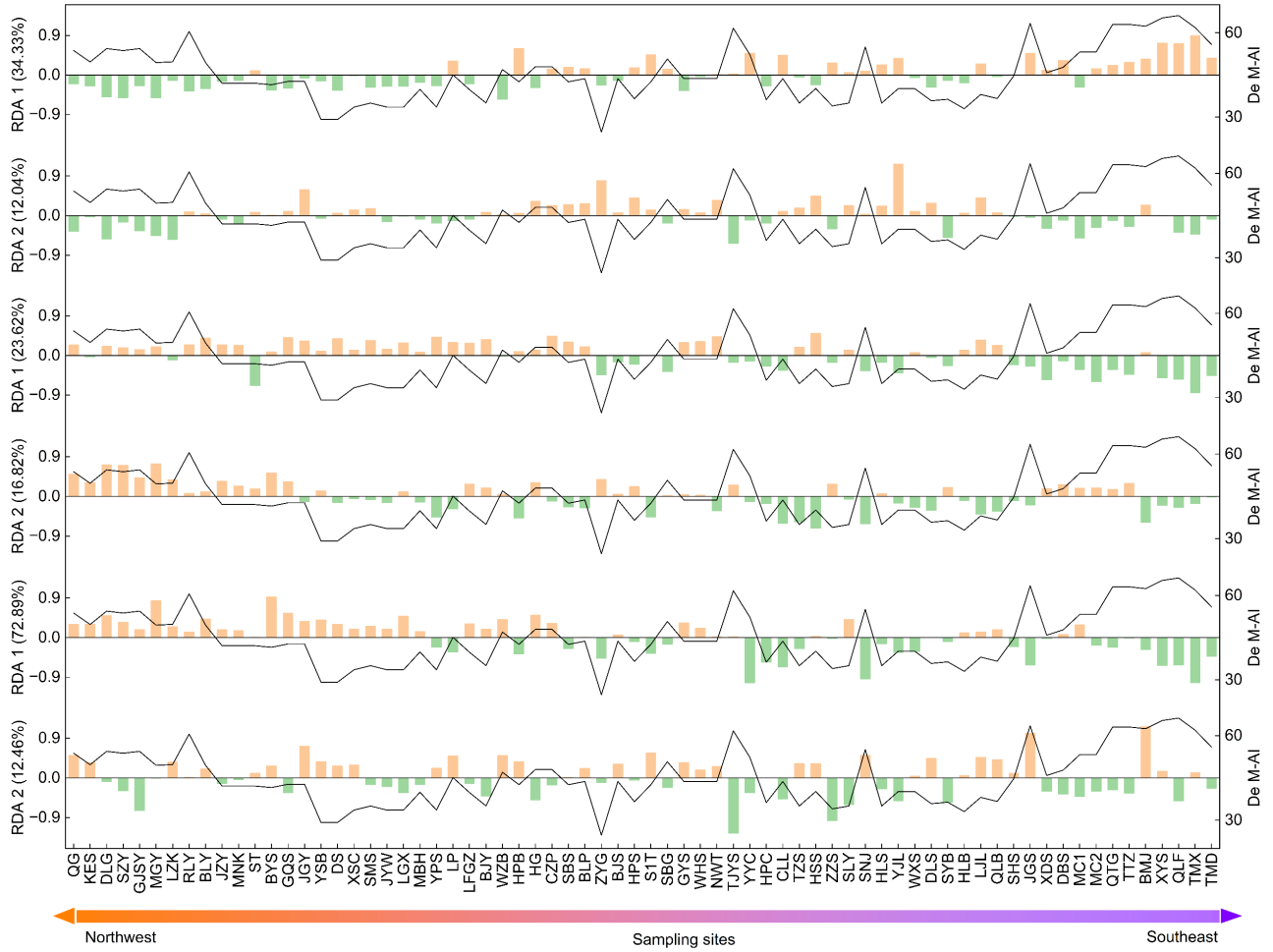

Figure S5 Redundancy analysis of three growth response relationships in the north-south transition zone of China. From top to bottom, the standardized scores of RDA1 and RDA2 of the growth relationship in response to temperature, precipitation and drought are shown. The right Y-axis is the De Martonne aridity index of each corresponding sampling point, and the lower axis is the sampling points sorted in the northwest-southeast direction.