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Supplementary information

Enhanced leaf turnover and nitrogen recycling sustain CO_2 fertilization effect on tree-ring growth

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Supplementary Information

for

Enhanced leaf turnover and nitrogen recycling sustain CO_2 fertilization effect on tree-ring growth

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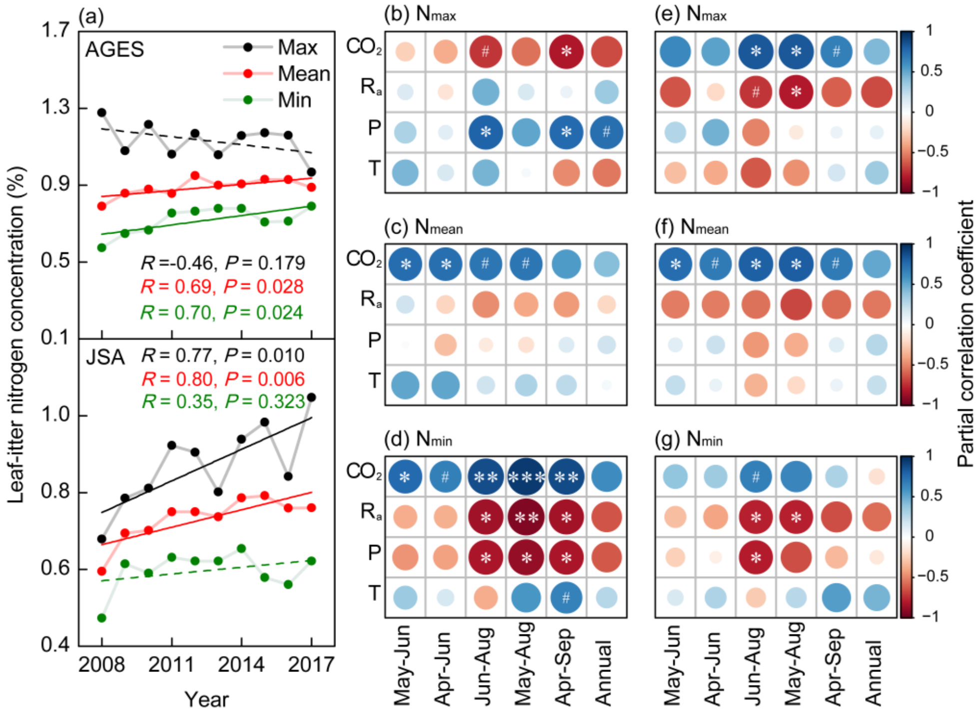
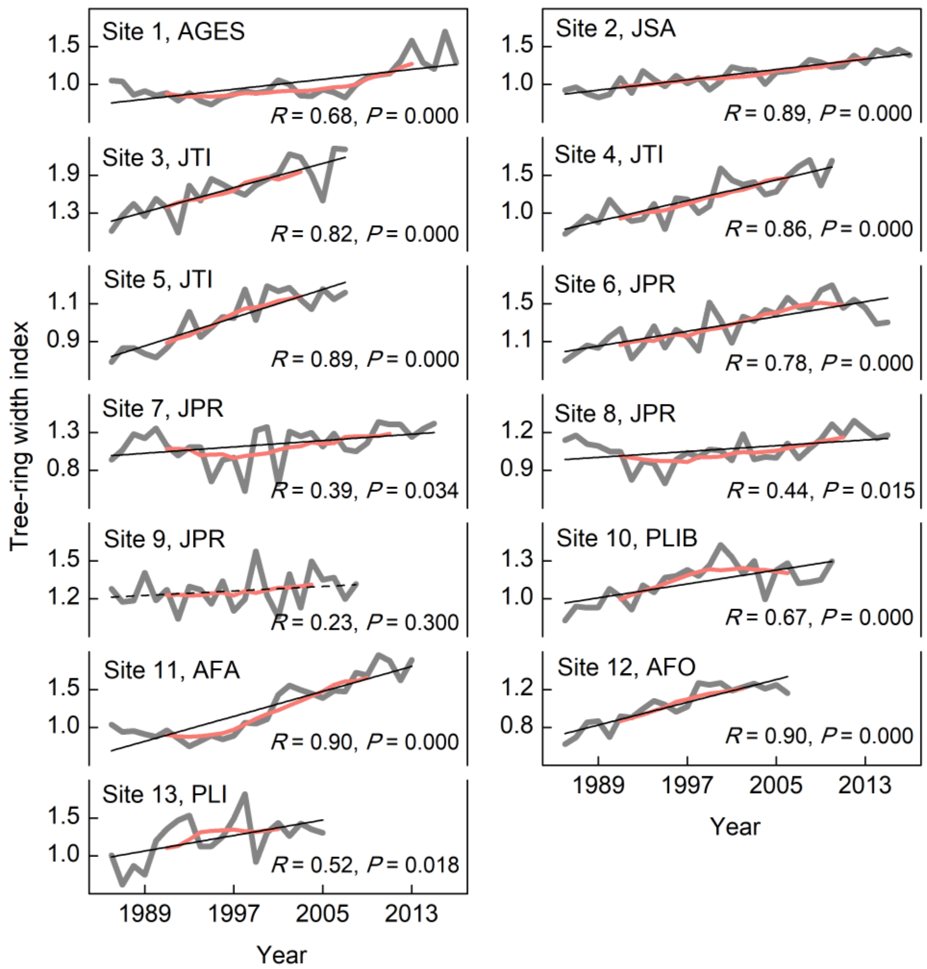
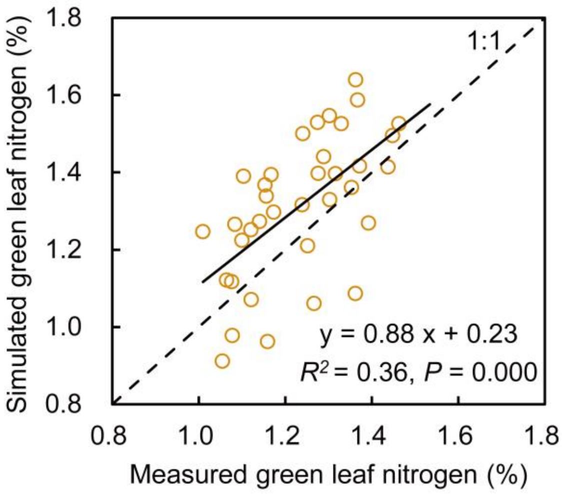


Supplementary Figure 1. Relative importance of climatic factors and atmospheric CO_2 concentration in determining interannual variations of leaf-litter nitrogen concentrations at two alpine treelines in the Sergyemla Mountains during 2007–2017. **(a)** Simple linear model was used for testing the variation trends in annual maximum (N_{max}, black solid circles), mean (N_{mean}, red solid circles) and minimum (N_{min}, green solid circles) leaf-litter nitrogen concentrations for *A. georgei* var. *smithii* (AGES) and *J. saltuaria* (JSA). **(b-g)** Partial correlation coefficients of multiple linear regressions for relationships of N_{max}, N_{mean} and N_{min} to observed seasonal/annual mean minimum temperature (T), precipitation (P) and solar radiation (R_a), and atmospheric CO_2 concentration (CO_2) at *A. georgei* var. *smithii* (b-d) and *J. saltuaria* (e-g) treelines, respectively. The significance of correlation coefficient is estimated by two-tailed t-test with no adjustment for multiple comparisons. Significant level: $^{\#}$ P <0.10, * P <0.05, ** P <0.01, *** P <0.001. The exact P values are found in Supplementary Table 3.



Supplementary Figure 2. Interannual trends in tree-ring width index (since 1986, thick gray lines) and their 10-year moving averages (thick red lines) across 8 tree species and 13 treeline sites on the Tibetan Plateau. The data were collected from this study (Sites 1-2) and the literature (Sites 3-13). The interannual trends were tested using simple linear model. The significance of correlation coefficient is estimated by two-tailed t-test with no adjustment for multiple comparisons.



Supplementary Figure 3. Relationship between seasonal measurements of green leaf nitrogen concentration (N_{green}) and the estimated N_{green} from leaf-litter nitrogen concentration (N_{litter}) at *A. georgei* var. *smithii* treeline in the Sergyemla Mountains, using a global empirical model (N_{green} = (N_{litter} / MLCF) / 0.60, MLCF is the mass loss correction factor, 0.745 for conifers used here)[46,47]. The relationship was tested using simple linear model. The significance of the regression equation is estimated using the F-test. The 1:1 dashed line indicates the one-to-one relationship.

Supplementary Table 1. Description of 13 treeline sites on the Tibetan Plateau collected from this study and the literature.

ID	Sites	Species	Abbr.	Latitude	Longitude	Altitude (m)	Duration	Data source
1	Nyingchi, Tibet	*Abies georgei* var. *smithii*	AGES	29.60	94.61	4320	1986–2017	This study
2	Nyingchi, Tibet	*Juniperus saltuaria*	JSA	29.61	94.60	4425	1986–2017	This study
3	Xiangcheng, Sichuan	*Juniperus tibetica*	JTI	28.90	99.75	3980	1986–2007	[1] Li et al. (2011)
4	Qamdo, Tibet	*Juniperus tibetica*	JTI	31.15	97.17	4350–4500	1986–2010	[2] Wang et al. (2014)
5	Deqin, Yunnan	*Juniperus tibetica*	JTI	28.37	99.03	4260	1986–2007	[3] Wright et al. (2011)
6	Wulan, Qinghai	*Juniperus przewalskii*	JPR	37.05	98.67	3972	1986–2015	[4] Song et al. (2018)
7	Dulan, Qinghai	*Juniperus przewalskii*	JPR	36.03	98.19	4024	1986–2015	[4] Song et al. (2018)
8	Tongde, Qinghai	*Juniperus przewalskii*	JPR	34.76	100.79	3791	1986–2015	[4] Song et al. (2018)
9	Qilian, Qinghai	*Juniperus przewalskii*	JPR	38.20	99.87	3300–3500	1986–2008	[5] Yang et al. (2014)
10	Basu, Tibet	*Picea likiangensis* var. *balfouriana*	PLIB	30.13	97.36	4630–4766	1986–2010	[6] Liu et al. (2015)
11	Songpan, Sichuan	*Abies faxoniana*	AFA	33.05	103.72	3620	1986–2013	[7] Guo et al. (2019)
12	Daocheng, Sichuan	*Abies forrestii*	AFO	29.28	100.08	4150	1986–2006	[8] Li et al. (2011)
13	Shangri-La, Yunnan	*Picea likiangensis*	PLI	27.58	99.35	3240	1986–2005	[9] Fan (2013)

Supplementary Table 2. Pearson correlation coefficients of annual litterfall and its associated nitrogen resorption and return collected in different periods (previous year's month to current year's month) to tree-ring width index (n=10) and annual stem increment (n=8 for *A. georgei* var. *smithii*, n=9 for *J. saltuaria*) at treelines in the Sergyemla Mountains during 2007–2017. The significance of correlation coefficient is estimated by two-tailed t-test with no adjustment for multiple comparisons. *P* values are shown in parentheses. Significant level: #*P*<0.10, **P*<0.05.

Period	Tree-ring width index		Annual stem increment	
	A. georgei var. *smithii*	*J. saltuaria*	*A. georgei* var. *smithii*	*J. saltuaria*
Litterfall as independent variable				
Pre-May 15 to May 15	/	**0.838* (0.002)**	/	**0.784* (0.012)**
Pre-Jun 15 to Jun 15	**0.730* (0.017)**	**0.697* (0.025)**	**0.857* (0.007)**	**0.720* (0.029)**
Pre-Jul 15 to Jul 15	**0.707* (0.022)**	**0.666* (0.036)**	**0.878* (0.004)**	**0.729* (0.026)**
Pre-Aug 15 to Aug 15	**0.578# (0.080)**	0.181 (0.617)	**0.864* (0.006)**	0.152 (0.697)
Pre-Sep 15 to Sep 15	0.574 (0.102)	–0.006 (0.988)	**0.828* (0.011)**	–0.008 (0.984)
Pre-Oct 15 to Oct 15	–0.043 (0.906)	0.072 (0.843)	0.012 (0.978)	0.119 (0.761)
N resorption as independent variable				
Pre-May 15 to May 15	/	**0.852* (0.002)**	/	**0.788* (0.012)**
Pre-Jun 15 to Jun 15	**0.760* (0.011)**	**0.706* (0.023)**	**0.864* (0.006)**	**0.747* (0.021)**
Pre-Jul 15 to Jul 15	**0.732* (0.016)**	**0.685* (0.029)**	**0.873* (0.005)**	**0.770* (0.015)**
Pre-Aug 15 to Aug 15	**0.571# (0.085)**	0.172 (0.635)	**0.856* (0.007)**	0.169 (0.663)
Pre-Sep 15 to Sep 15	0.524 (0.120)	0.023 (0.949)	**0.806* (0.016)**	0.022 (0.956)
Pre-Oct 15 to Oct 15	0.044 (0.904)	0.102 (0.779)	0.151 (0.721)	0.149 (0.701)
N return as independent variable				
Pre-May 15 to May 15	/	**0.852* (0.002)**	/	**0.788* (0.012)**
Pre-Jun 15 to Jun 15	**0.760* (0.011)**	**0.706* (0.023)**	**0.864* (0.006)**	**0.747* (0.021)**
Pre-Jul 15 to Jul 15	**0.732* (0.016)**	**0.685* (0.029)**	**0.873* (0.005)**	**0.770* (0.015)**
Pre-Aug 15 to Aug 15	**0.571# (0.085)**	0.172 (0.635)	**0.856* (0.007)**	0.169 (0.663)
Pre-Sep 15 to Sep 15	0.524 (0.120)	0.023 (0.949)	**0.806* (0.016)**	0.022 (0.956)
Pre-Oct 15 to Oct 15	0.044 (0.904)	0.102 (0.779)	0.151 (0.721)	0.149 (0.701)

Supplementary Table 3. Partial correlation coefficients of multiple linear regressions for relationships of annual litterfall, annual nitrogen resorption (N-res) and return (N-ret), annual maximum (N_{max}), mean (N_{mean}) and minimum (N_{min}) leaf-litter nitrogen concentrations, and tree-ring width index (TRWI) to current year's seasonal/annual mean minimum temperature (T), precipitation (P), solar radiation (R_a) and atmospheric CO_2 concentration (CO_2) (Model 1), or to previous year's seasonal/annual mean minimum temperature (PT), precipitation (PP), solar radiation (PR_a) and atmospheric CO_2 concentration (PCO_2) (Model 2) at *A. georgei* var. *smithii* and *J. saltuaria* treelines in the Sergyemla Mountains during 2007–2017. The statistical significance is estimated by two-tailed t-test with no adjustment for multiple comparisons. *P* values are shown in parentheses. Significant level: #*P* <0.10, **P* <0.05.

Seasons	Model 1				Model 2			
	T	P	R_a	CO_2	PT	PP	PR_a	PCO_2
Litterfall of *A. georgei* var. *smithii* as dependent variable								
May-Jun	0.49	– 0.19	0.35	**0.84***	0.23	– 0.10	– 0.23	**0.73#**
	(0.263)	(0.688)	(0.448)	**(0.018)**	(0.616)	(0.836)	(0.626)	**(0.065)**
Apr-June	0.18	– 0.23	– 0.16	**0.74#**	– 0.45	0.15	– 0.23	**0.73#**
	(0.703)	(0.615)	(0.736)	**(0.056)**	(0.314)	(0.749)	(0.626)	**(0.065)**
Jun-Aug	0.03	0.28	0.23	**0.75#**	**– 0.83***	– 0.56	**– 0.88***	**0.93***
	(0.942)	(0.550)	(0.618)	**(0.051)**	**(0.020)**	(0.187)	**(0.009)**	**(0.002)**
May-Aug	– 0.17	– 0.03	0.25	**0.72#**	– 0.54	0.05	**– 0.77***	**0.83***
	(0.714)	(0.955)	(0.587)	**(0.068)**	(0.211)	(0.913)	**(0.044)**	**(0.021)**
Apr-Sep	– 0.57	0.38	0.20	**0.69#**	**– 0.79***	0.05	**– 0.86***	**0.81***
	(0.178)	(0.401)	(0.669)	**(0.083)**	**(0.035)**	(0.923)	**(0.013)**	**(0.026)**
Annual	– 0.40	0.37	0.29	**0.72#**	– 0.61	0.08	**– 0.72#**	**0.78***
	(0.380)	(0.416)	(0.531)	**(0.066)**	(0.145)	(0.865)	**(0.066)**	**(0.038)**
N-res of *A. georgei* var. *smithii* as dependent variable								
May-Jun	0.53	– 0.04	0.24	**0.86***	0.42	– 0.09	– 0.23	**0.77***
	(0.222)	(0.935)	(0.610)	**(0.014)**	(0.349)	(0.844)	(0.625)	**(0.042)**

Apr-June	0.39	– 0.26	– 0.32	**0.81***	– 0.24	0.05	– 0.28	**0.71#**
	(0.389)	(0.573)	(0.478)	**(0.028)**	(0.604)	(0.916)	(0.550)	**(0.075)**
Jun-Aug	0.02	0.15	0.20	**0.78***	– 0.66	– 0.37	**– 0.83***	**0.91***
	(0.970)	(0.740)	(0.671)	**(0.039)**	(0.105)	(0.413)	**(0.022)**	**(0.005)**
May-Aug	– 0.13	– 0.06	0.23	**0.76***	– 0.35	0.18	**– 0.80***	**0.87***
	(0.786)	(0.895)	(0.614)	**(0.048)**	(0.440)	(0.704)	**(0.032)**	**(0.011)**
Apr-Sep	– 0.47	0.37	0.16	**0.72#**	– 0.59	– 0.15	**– 0.87***	**0.82***
	(0.289)	(0.407)	(0.731)	**(0.071)**	(0.160)	(0.743)	**(0.011)**	**(0.023)**
Annual	– 0.31	0.40	0.25	**0.73#**	– 0.29	– 0.29	**– 0.80***	**0.76***
	(0.505)	(0.375)	(0.585)	**(0.062)**	(0.530)	(0.535)	**(0.031)**	**(0.045)**
N-ret of *A. georgei* var. *smithii* as dependent variable								
May-Jun	0.53	– 0.04	0.24	**0.86***	0.42	– 0.09	– 0.23	**0.77***
	(0.222)	(0.935)	(0.610)	**(0.014)**	(0.349)	(0.844)	(0.625)	**(0.042)**
Apr-June	0.39	– 0.26	– 0.32	**0.81***	– 0.24	0.05	– 0.28	**0.71#**
	(0.389)	(0.573)	(0.478)	**(0.028)**	(0.604)	(0.916)	(0.550)	**(0.075)**
Jun-Aug	0.02	0.15	0.20	**0.78***	– 0.66	– 0.37	**– 0.83***	**0.91***
	(0.970)	(0.740)	(0.672)	**(0.039)**	(0.105)	(0.413)	**(0.022)**	**(0.005)**
May-Aug	– 0.13	– 0.06	0.23	**0.76***	– 0.35	0.18	**– 0.80***	**0.87***
	(0.787)	(0.895)	(0.614)	**(0.048)**	(0.440)	(0.705)	**(0.032)**	**(0.011)**
Apr-Sep	– 0.47	0.37	0.16	**0.72#**	– 0.59	– 0.15	**– 0.87***	**0.82***
	(0.289)	(0.407)	(0.731)	**(0.071)**	(0.160)	(0.743)	**(0.011)**	**(0.023)**
Annual	– 0.31	0.40	0.25	**0.73#**	– 0.29	– 0.29	**– 0.80***	**0.76***
	(0.505)	(0.375)	(0.585)	**(0.062)**	(0.530)	(0.534)	**(0.031)**	**(0.045)**
N_{max} of *A. georgei* var. *smithii* as dependent variable								
May-Jun	0.46	0.32	0.15	– 0.23	– 0.28	– 0.10	– 0.37	– 0.54
	(0.301)	(0.490)	(0.741)	(0.618)	(0.542)	(0.833)	(0.420)	(0.210)
Apr-June	0.17	0.13	– 0.14	– 0.37	– 0.61	0.32	– 0.27	– 0.60
	(0.721)	(0.782)	(0.760)	(0.416)	(0.147)	(0.486)	(0.554)	(0.158)

Jun-Aug	0.47	**0.80***	0.48	**– 0.72#**	**– 0.70#**	– 0.64	– 0.55	– 0.55
	(0.289)	**(0.031)**	(0.276)	**(0.069)**	**(0.077)**	(0.123)	(0.204)	(0.202)
May-Aug	0.04	0.53	0.16	– 0.55	– 0.49	– 0.31	– 0.40	– 0.63
	(0.932)	(0.223)	(0.727)	(0.205)	(0.266)	(0.502)	(0.374)	(0.133)
Apr-Sep	– 0.47	**0.78***	0.08	**– 0.81***	– 0.53	– 0.18	– 0.32	– 0.61
	(0.284)	**(0.039)**	(0.863)	**(0.028)**	(0.221)	(0.697)	(0.491)	(0.148)
Annual	– 0.52	**0.75#**	0.37	– 0.65	0.00	– 0.09	– 0.35	– 0.56
	(0.229)	**(0.052)**	(0.414)	(0.112)	(0.993)	(0.844)	(0.439)	(0.187)
N_{mean} of *A. georgei* var. *smithii* as dependent variable								
May-Jun	0.52	0.02	0.20	**0.76***	0.57	– 0.48	**– 0.70#**	**0.75#**
	(0.231)	(0.966)	(0.665)	**(0.046)**	(0.177)	(0.270)	**(0.080)**	**(0.051)**
Apr-June	0.52	– 0.31	– 0.21	**0.76***	0.61	**– 0.74#**	**– 0.81***	0.53
	(0.229)	(0.499)	(0.647)	**(0.049)**	(0.142)	**(0.059)**	**(0.027)**	(0.218)
Jun-Aug	0.20	– 0.12	– 0.47	**0.72#**	– 0.24	– 0.32	– 0.36	**0.69#**
	(0.661)	(0.804)	(0.292)	**(0.067)**	(0.605)	(0.488)	(0.423)	**(0.088)**
May-Aug	0.31	– 0.15	– 0.38	**0.72#**	– 0.15	– 0.34	– 0.65	**0.70#**
	(0.493)	(0.744)	(0.396)	**(0.066)**	(0.754)	(0.449)	(0.113)	**(0.079)**
Apr-Sep	0.27	0.15	– 0.43	0.57	0.15	**– 0.73#**	**– 0.67#**	**0.74#**
	(0.562)	(0.752)	(0.341)	(0.184)	(0.747)	**(0.064)**	**(0.096)**	**(0.058)**
Annual	0.05	0.21	– 0.21	0.43	0.31	**– 0.82***	**– 0.73#**	0.65
	(0.917)	(0.657)	(0.657)	(0.340)	(0.502)	**(0.025)**	**(0.063)**	(0.112)
N_{min} of *A. georgei* var. *smithii* as dependent variable								
May-Jun	0.37	– 0.44	– 0.36	**0.77***	0.48	– 0.12	– 0.05	**0.69#**
	(0.419)	(0.318)	(0.422)	**(0.041)**	(0.278)	(0.795)	(0.911)	**(0.089)**
Apr-June	0.18	– 0.40	– 0.35	**0.68#**	**0.88***	**– 0.76***	– 0.50	**0.80***
	(0.700)	(0.371)	(0.440)	**(0.091)**	**(0.009)**	**(0.046)**	(0.256)	**(0.030)**
Jun-Aug	– 0.37	**– 0.82***	**– 0.84***	**0.89***	0.40	– 0.30	– 0.14	**0.79***
	(0.418)	**(0.025)**	**(0.017)**	**(0.008)**	(0.372)	(0.518)	(0.773)	**(0.036)**

May-Aug	0.58	**– 0.87***	**– 0.93***	**0.95***	0.52	– 0.35	– 0.18	**0.80***
	(0.171)	**(0.010)**	**(0.003)**	**(0.001)**	(0.237)	(0.446)	(0.695)	**(0.032)**
Apr-Sep	**0.68#**	**– 0.81***	**– 0.83***	**0.89***	**0.72#**	– 0.50	– 0.11	**0.82***
	(0.094)	**(0.026)**	**(0.020)**	**(0.007)**	**(0.067)**	(0.249)	(0.810)	**(0.023)**
Annual	0.29	– 0.61	– 0.62	0.62	0.21	– 0.39	– 0.03	0.66
	(0.533)	(0.145)	(0.136)	(0.135)	(0.653)	(0.383)	(0.954)	(0.110)
TRWI of *A. georgei* var. *smithii* as dependent variable								
May-Jun	0.59	– 0.56	0.54	**0.90***	0.10	0.02	0.02	**0.70#**
	(0.120)	(0.148)	(0.163)	**(0.003)**	(0.807)	(0.954)	(0.963)	**(0.052)**
Apr-June	**0.67#**	**– 0.75***	0.15	**0.90***	0.16	– 0.04	0.03	**0.64#**
	(0.071)	**(0.033)**	(0.731)	**(0.002)**	(0.705)	(0.918)	(0.939)	**(0.086)**
Jun-Aug	0.41	– 0.30	0.17	**0.85***	– 0.32	0.09	– 0.57	**0.74***
	(0.314)	(0.468)	(0.690)	**(0.007)**	(0.433)	(0.825)	(0.143)	**(0.035)**
May-Aug	0.56	**– 0.71***	0.41	**0.92***	– 0.22	0.18	– 0.51	**0.72***
	(0.148)	**(0.047)**	(0.312)	**(0.001)**	(0.602)	(0.678)	(0.193)	**(0.043)**
Apr-Sep	0.21	– 0.43	0.18	**0.81***	0.00	0.20	– 0.36	0.56
	(0.624)	(0.285)	(0.664)	**(0.015)**	(0.999)	(0.640)	(0.385)	(0.149)
Annual	– 0.17	– 0.26	0.36	**0.79***	– 0.43	0.18	– 0.01	**0.70#**
	(0.690)	(0.536)	(0.377)	**(0.019)**	(0.282)	(0.676)	(0.990)	**(0.051)**
Litterfall of *Juniperus saltuaria* as dependent variable								
May-Jun	0.10	– 0.63	0.54	**0.70#**	0.27	0.43	0.02	0.47
	(0.830)	(0.127)	(0.213)	**(0.078)**	(0.551)	(0.336)	(0.961)	(0.281)
Apr-June	– 0.34	– 0.50	0.25	0.52	– 0.60	0.54	0.37	0.48
	(0.452)	(0.256)	(0.594)	(0.230)	(0.155)	(0.212)	(0.409)	(0.275)
Jun-Aug	0.21	0.22	0.38	0.50	– 0.46	0.15	– 0.44	0.54
	(0.658)	(0.639)	(0.394)	(0.258)	(0.305)	(0.745)	(0.321)	(0.215)
May-Aug	– 0.07	– 0.23	0.31	0.57	– 0.12	0.47	– 0.14	0.43
	(0.881)	(0.619)	(0.495)	(0.185)	(0.797)	(0.288)	(0.773)	(0.340)

Apr-Sep	– 0.61	– 0.59	0.40	**0.74#**	– 0.64	0.61	– 0.32	0.15
	(0.143)	(0.165)	(0.373)	**(0.056)**	(0.121)	(0.145)	(0.489)	(0.742)
Annual	– 0.46	– 0.63	0.40	**0.74#**	**– 0.72#**	0.56	0.05	0.50
	(0.299)	(0.129)	(0.378)	**(0.056)**	**(0.069)**	(0.191)	(0.916)	(0.252)
N-res of *Juniperus saltuaria* as dependent variable								
May-Jun	0.12	– 0.62	0.40	**0.81***	0.55	0.54	– 0.06	**0.74#**
	(0.801)	(0.141)	(0.368)	**(0.026)**	(0.199)	(0.211)	(0.897)	**(0.057)**
Apr-June	– 0.14	– 0.46	– 0.02	**0.71#**	– 0.42	0.45	0.19	0.66
	(0.760)	(0.300)	(0.966)	**(0.074)**	(0.350)	(0.314)	(0.678)	(0.105)
Jun-Aug	0.17	0.06	0.36	**0.74#**	– 0.51	0.09	– 0.61	**0.81***
	(0.718)	(0.894)	(0.422)	**(0.057)**	(0.241)	(0.840)	(0.146)	**(0.029)**
May-Aug	– 0.16	– 0.45	0.25	**0.79***	– 0.05	0.58	– 0.31	**0.73#**
	(0.733)	(0.309)	(0.582)	**(0.034)**	(0.917)	(0.169)	(0.497)	**(0.061)**
Apr-Sep	– 0.58	– 0.55	0.37	**0.84***	– 0.58	0.59	– 0.56	0.54
	(0.170)	(0.201)	(0.407)	**(0.017)**	(0.175)	(0.166)	(0.190)	(0.214)
Annual	– 0.31	– 0.48	0.32	**0.78***	**– 0.74#**	0.57	– 0.21	**0.75#**
	(0.506)	(0.275)	(0.485)	**(0.038)**	**(0.055)**	(0.177)	(0.657)	**(0.051)**
N-ret of *Juniperus saltuaria* as dependent variable								
May-Jun	0.12	– 0.62	0.40	**0.81***	0.55	0.54	– 0.06	**0.74#**
	(0.802)	(0.141)	(0.368)	**(0.026)**	(0.199)	(0.211)	(0.897)	**(0.057)**
Apr-June	– 0.14	– 0.46	– 0.02	**0.71#**	– 0.42	0.45	0.19	0.66
	(0.760)	(0.300)	(0.966)	**(0.075)**	(0.350)	(0.314)	(0.678)	(0.105)
Jun-Aug	0.17	0.06	0.36	**0.74#**	– 0.51	0.09	– 0.61	**0.81***
	(0.718)	(0.894)	(0.422)	**(0.057)**	(0.241)	(0.840)	(0.146)	**(0.029)**
May-Aug	– 0.16	– 0.45	0.25	**0.79***	– 0.05	0.58	– 0.31	**0.73#**
	(0.733)	(0.310)	(0.582)	**(0.034)**	(0.918)	(0.169)	(0.497)	**(0.061)**
Apr-Sep	– 0.58	– 0.55	0.37	**0.84***	– 0.58	0.59	– 0.56	0.54
	(0.169)	(0.201)	(0.407)	**(0.017)**	(0.175)	(0.166)	(0.190)	(0.214)

Annual	– 0.31	– 0.48	0.32	**0.78***	**– 0.74#**	0.57	– 0.21	**0.75#**
	(0.506)	(0.275)	(0.485)	**(0.038)**	**(0.055)**	(0.177)	(0.657)	**(0.051)**
N_{max} of *Juniperus saltuaria* as dependent variable								
May-Jun	– 0.30	0.29	– 0.63	0.65	0.23	– 0.39	– 0.19	**0.82***
	(0.510)	(0.528)	(0.130)	(0.118)	(0.621)	(0.392)	(0.683)	**(0.024)**
Apr-June	– 0.38	0.48	– 0.19	0.54	**0.92***	**– 0.87***	**– 0.87***	**0.95***
	(0.406)	(0.279)	(0.682)	(0.212)	**(0.004)**	**(0.011)**	**(0.012)**	**(0.001)**
Jun-Aug	– 0.61	– 0.49	**– 0.71#**	**0.84***	0.41	– 0.31	0.38	**0.89***
	(0.143)	(0.261)	**(0.072)**	**(0.017)**	(0.361)	(0.499)	(0.403)	**(0.008)**
May-Aug	– 0.46	– 0.12	**– 0.79***	**0.85***	0.30	– 0.50	0.10	**0.88***
	(0.303)	(0.799)	**(0.033)**	**(0.016)**	(0.510)	(0.255)	(0.824)	**(0.010)**
Apr-Sep	0.19	0.08	– 0.60	**0.69#**	0.65	**– 0.70#**	0.18	**0.92***
	(0.689)	(0.861)	(0.157)	**(0.087)**	(0.115)	**(0.080)**	(0.707)	**(0.003)**
Annual	0.36	0.11	– 0.66	0.45	0.48	– 0.51	– 0.01	**0.82***
	(0.431)	(0.819)	(0.109)	(0.313)	(0.277)	(0.244)	(0.984)	**(0.025)**
N_{mean} of *Juniperus saltuaria* as dependent variable								
May-Jun	0.24	0.13	– 0.52	**0.76***	**0.74#**	– 0.18	– 0.47	**0.88***
	(0.602)	(0.788)	(0.232)	**(0.047)**	**(0.055)**	(0.698)	(0.283)	**(0.009)**
Apr-June	0.09	0.21	– 0.51	**0.70#**	**0.76***	– 0.57	**– 0.74#**	**0.85***
	(0.845)	(0.645)	(0.241)	**(0.080)**	**(0.049)**	(0.181)	**(0.058)**	**(0.015)**
Jun-Aug	– 0.34	– 0.44	– 0.54	**0.81***	– 0.07	– 0.52	– 0.45	**0.85***
	(0.450)	(0.325)	(0.208)	**(0.026)**	(0.878)	(0.235)	(0.315)	**(0.015)**
May-Aug	– 0.19	– 0.37	– 0.66	**0.83***	0.22	– 0.32	– 0.48	**0.83***
	(0.680)	(0.415)	(0.104)	**(0.021)**	(0.643)	(0.481)	(0.277)	**(0.020)**
Apr-Sep	0.09	0.13	– 0.56	**0.70#**	0.46	– 0.51	– 0.53	**0.81***
	(0.851)	(0.775)	(0.188)	**(0.077)**	(0.302)	(0.247)	(0.222)	**(0.026)**
Annual	0.24	0.29	– 0.53	0.52	0.16	– 0.32	– 0.30	0.66
	(0.609)	(0.531)	(0.223)	(0.236)	(0.731)	(0.482)	(0.512)	(0.107)
N_{min} of *Juniperus saltuaria* as dependent variable								

May-Jun	0.16	– 0.23	– 0.31	0.39	0.51	– 0.25	0.11	0.43
	(0.730)	(0.613)	(0.503)	(0.384)	(0.245)	(0.588)	(0.808)	(0.334)
Apr-June	0.30	– 0.08	– 0.40	0.35	**0.80***	**– 0.74#**	– 0.40	0.64
	(0.509)	(0.857)	(0.375)	(0.436)	**(0.030)**	**(0.057)**	(0.368)	(0.120)
Jun-Aug	– 0.25	**– 0.78***	**– 0.78***	**0.69#**	0.34	– 0.16	0.04	0.41
	(0.588)	**(0.038)**	**(0.041)**	**(0.087)**	(0.455)	(0.732)	(0.938)	(0.367)
May-Aug	0.27	– 0.65	**– 0.77***	0.66	0.33	– 0.19	– 0.01	0.45
	(0.554)	(0.115)	**(0.041)**	(0.108)	(0.466)	(0.681)	(0.985)	(0.308)
Apr-Sep	0.56	– 0.33	– 0.64	0.32	0.45	– 0.34	0.02	0.51
	(0.193)	(0.471)	(0.119)	(0.484)	(0.309)	(0.460)	(0.965)	(0.247)
Annual	0.47	– 0.12	– 0.56	– 0.16	– 0.16	– 0.20	0.31	0.48
	(0.289)	(0.796)	(0.193)	(0.735)	(0.729)	(0.659)	(0.502)	(0.273)
TRWI of *Juniperus saltuaria* as dependent variable								
May-Jun	0.26	– 0.31	0.39	**0.81***	– 0.09	– 0.07	– 0.33	**0.74***
	(0.528)	(0.454)	(0.334)	**(0.014)**	(0.829)	(0.876)	(0.419)	**(0.037)**
Apr-June	– 0.29	– 0.44	0.21	**0.77***	– 0.33	0.14	– 0.26	**0.69#**
	(0.493)	(0.279)	(0.621)	**(0.026)**	(0.426)	(0.736)	(0.530)	**(0.060)**
Jun-Aug	0.58	**0.68#**	0.34	**0.75***	**– 0.76***	– 0.57	– 0.48	**0.88***
	(0.133)	**(0.066)**	(0.412)	**(0.032)**	**(0.029)**	(0.139)	(0.226)	**(0.004)**
May-Aug	0.31	0.36	0.01	**0.74***	– 0.60	– 0.41	– 0.36	**0.79***
	(0.457)	(0.378)	(0.978)	**(0.036)**	(0.119)	(0.313)	(0.382)	**(0.019)**
Apr-Sep	– 0.14	– 0.12	– 0.30	**0.69#**	**– 0.66#**	– 0.20	0.04	**0.77***
	(0.748)	(0.769)	(0.471)	**(0.060)**	**(0.074)**	(0.640)	(0.931)	**(0.026)**
Annual	– 0.13	– 0.39	– 0.21	**0.64#**	– 0.58	– 0.05	0.12	**0.76***
	(0.754)	(0.341)	(0.615)	**(0.088)**	(0.132)	(0.905)	(0.773)	**(0.028)**

Supplementary Table 4. Estimates of regression weights for structural equation models quantifying direct effects of climatic factors and atmospheric CO_2 and their indirect effects through interactions with litterfall and N-ret/N-res on tree-ring width index (TRWI) in *A. georgei* var. *smithii* and *J. saltuaria* treeline forests in the Sergyemla Mountains during 2007–2017.

Paths	Estimate	Std. Error	Critical Ratio	*P* value
A. georgei var. *smithii* treeline forest				
Litterfall <--- CO_2	2.356	0.786	2.998	0.003
Litterfall <--- P	– 0.011	0.060	– 0.181	0.856
Litterfall <--- T	– 8.989	18.187	– 0.494	0.621
N-ret/res <--- CO_2	0.004	0.003	1.262	0.207
N-ret/res <--- P	0.000	0.000	– 0.371	0.710
N-ret/res <--- T	0.019	0.048	0.387	0.699
N-ret/res <--- Litterfall	0.009	0.001	9.840	0.000
TRWI <--- CO_2	0.013	0.005	2.808	0.005
TRWI <--- P	– 0.001	0.000	– 5.090	0.000
TRWI <--- T	0.196	0.072	2.713	0.007
TRWI <--- N-ret/res	0.604	0.147	4.097	0.000
Juniperus saltuaria treeline forest				
Litterfall <--- CO_2	2.495	1.272	1.961	0.050
Litterfall <--- P	– 0.127	0.115	– 1.103	0.270
Litterfall <--- T	– 13.146	34.975	– 0.376	0.707
N-ret/res <--- CO_2	0.015	0.004	4.139	0.000
N-ret/res <--- P	– 0.001	0.000	– 2.080	0.038
N-ret/res <--- T	– 0.052	0.081	– 0.644	0.520
N-ret/res <--- Litterfall	0.005	0.001	6.876	0.000
TRWI <--- CO_2	– 0.002	0.003	– 0.609	0.543
TRWI <--- P	0.001	0.000	4.405	0.000
TRWI <--- T	0.111	0.044	2.512	0.012
TRWI <--- N-ret/res	0.328	0.072	4.566	0.000

Supplementary Table 5. Partial correlation coefficients of multiple linear regressions for relationships of tree-ring width index to previous and current year's monthly/seasonal mean minimum temperature (PT, T) and precipitation (PP, P) from May to August and the atmospheric CO_2 concentration, based on the chronological data (since 1986) of tree-ring width index across 8 tree species and 13 treeline sites on the Tibetan Plateau collected from this study and the literature. Detailed sites information is found in Supplementary Table 1. The statistical significance is estimated by two-tailed t-test with no adjustment for multiple comparisons. *P* values are shown in parentheses. Significant level: #*P* <0.10, **P* <0.05.

Site ID	Species	Month	Partial correlation coefficient				
			PT	PP	T	P	CO_2
1	*Abies georgei* var. *smithii*	May	– 0.144	0.005	**– 0.486***	– 0.171	**0.793***
			(0.466)	(0.981)	**(0.009)**	(0.383)	**(0.000)**
		Jun	0.005	0.211	0.141	0.040	**0.484***
			(0.980)	(0.282)	(0.475)	(0.842)	**(0.009)**
		Jul	**– 0.369#**	– 0.063	0.150	– 0.090	**0.656***
			(0.053)	(0.750)	(0.445)	(0.647)	**(0.000)**
		Aug	**– 0.487***	**0.373#**	**– 0.474***	0.025	**0.846***
			(0.009)	**(0.051)**	**(0.011)**	(0.901)	**(0.000)**
		May-Jun	– 0.192	0.137	– 0.295	– 0.065	**0.709***
			(0.327)	(0.487)	(0.127)	(0.742)	**(0.000)**
		Jun-Aug	**– 0.456***	0.264	– 0.023	– 0.128	**0.738***
			(0.015)	(0.174)	(0.909)	(0.515)	**(0.000)**
		May-Aug	**– 0.502***	0.262	– 0.189	– 0.134	**0.785***
			(0.006)	(0.178)	(0.335)	(0.497)	**(0.000)**
2	*Juniperus saltuaria*	May	– 0.182	0.062	– 0.115	– 0.199	**0.852***
			(0.354)	(0.755)	(0.561)	(0.310)	**(0.000)**
		Jun	– 0.316	– 0.099	– 0.126	– 0.078	**0.840***
			(0.101)	(0.616)	(0.522)	(0.695)	**(0.000)**

		Jul	**– 0.341#**	0.087	0.142	0.034	**0.839***
			(0.076)	(0.660)	(0.470)	(0.864)	**(0.001)**
		Aug	**– 0.410***	– 0.036	0.051	0.132	**0.888***
			(0.030)	(0.857)	(0.795)	(0.504)	**(0.000)**
		May-Jun	– 0.251	0.002	– 0.223	– 0.049	**0.846***
			(0.197)	(0.991)	(0.253)	(0.803)	**(0.000)**
		Jun-Aug	**– 0.457***	– 0.089	0.083	0.096	**0.861***
			(0.014)	(0.651)	(0.673)	(0.626)	**(0.000)**
		May-Aug	**– 0.515***	0.004	0.065	0.007	**0.860***
			(0.005)	(0.984)	(0.742)	(0.970)	**(0.000)**
3	*Juniperus tibetica*	May	– 0.041	– 0.082	0.119	0.363	**0.729***
			(0.872)	(0.747)	(0.638)	(0.139)	**(0.001)**
		Jun	0.062	– 0.049	– 0.195	0.300	**0.722***
			(0.807)	(0.848)	(0.439)	(0.227)	**(0.001)**
		Jul	– 0.035	0.001	0.179	– 0.161	**0.735***
			(0.889)	(0.996)	(0.476)	(0.524)	**(0.001)**
		Aug	**– 0.433#**	0.193	– 0.170	– 0.061	**0.770***
			(0.073)	(0.443)	(0.500)	(0.811)	**(0.000)**
		May-Jun	0.169	– 0.283	0.028	**0.407#**	**0.706***
			(0.503)	(0.256)	(0.911)	**(0.094)**	**(0.001)**
		Jun-Aug	– 0.333	0.215	– 0.174	– 0.156	**0.728***
			(0.177)	(0.392)	(0.489)	(0.537)	**(0.001)**
		May-Aug	– 0.081	– 0.032	0.171	– 0.010	**0.612***
			(0.749)	(0.899)	(0.497)	(0.967)	**(0.007)**
4	*Juniperus tibetica*	May	0.308	**0.409#**	**– 0.535***	0.293	**0.888***
			(0.174)	**(0.066)**	**(0.013)**	(0.197)	**(0.000)**
		Jun	**0.418#**	– 0.169	**– 0.492***	– 0.105	**0.904***
			(0.059)	(0.464)	**(0.023)**	(0.651)	**(0.000)**

		Jul	0.319	– 0.058	– 0.190	0.216	**0.807***
			(0.159)	(0.803)	(0.409)	(0.346)	**(0.000)**
		Aug	– 0.222	0.233	– 0.006	– 0.198	**0.735***
			(0.332)	(0.310)	(0.978)	(0.390)	**(0.000)**
		May-Jun	**0.428#**	0.027	**– 0.589***	– 0.124	**0.898***
			(0.053)	(0.908)	**(0.005)**	(0.594)	**(0.000)**
		Jun-Aug	0.340	– 0.188	– 0.364	0.085	**0.783***
			(0.132)	(0.414)	(0.105)	(0.716)	**(0.000)**
		May-Aug	0.344	– 0.126	**– 0.473***	0.097	**0.821***
			(0.127)	(0.585)	**(0.030)**	(0.674)	**(0.000)**
5	*Juniperus tibetica*	May	0.159	– 0.017	– 0.026	– 0.106	**0.815***
			(0.528)	(0.948)	(0.919)	(0.677)	**(0.000)**
		Jun	0.091	– 0.134	0.021	– 0.048	**0.823***
			(0.720)	(0.595)	(0.935)	(0.849)	**(0.000)**
		Jul	– 0.072	– 0.108	**0.460#**	– 0.187	**0.653***
			(0.776)	(0.670)	**(0.055)**	(0.458)	**(0.003)**
		Aug	– 0.066	0.099	**0.438#**	**0.630***	**0.784***
			(0.794)	(0.695)	**(0.069)**	**(0.005)**	**(0.000)**
		May-Jun	0.187	– 0.098	– 0.030	– 0.144	**0.827***
			(0.458)	(0.700)	(0.906)	(0.568)	**(0.000)**
		Jun-Aug	– 0.238	0.187	0.326	0.269	**0.698***
			(0.341)	(0.457)	(0.187)	(0.280)	**(0.001)**
		May-Aug	– 0.254	0.313	0.318	0.234	**0.757***
			(0.310)	(0.206)	(0.198)	(0.350)	**(0.000)**
6	*Juniperus przewalskii*	May	0.195	0.036	– 0.040	0.149	**0.777***
			(0.339)	(0.861)	(0.847)	(0.467)	**(0.000)**
		Jun	– 0.025	– 0.216	0.191	0.187	**0.786***
			(0.903)	(0.289)	(0.349)	(0.361)	**(0.000)**

		Jul	– 0.002	0.209	**0.359#**	0.254	**0.741***
			(0.993)	(0.306)	**(0.072)**	(0.211)	**(0.000)**
		Aug	– 0.163	0.193	0.237	0.180	**0.770***
			(0.427)	(0.346)	(0.243)	(0.379)	**(0.000)**
		May-Jun	0.190	– 0.114	0.080	0.241	**0.782***
			(0.354)	(0.579)	(0.697)	(0.236)	**(0.000)**
		Jun-Aug	– 0.235	0.313	**0.568***	**0.535***	**0.741***
			(0.248)	(0.119)	**(0.002)**	**(0.005)**	**(0.000)**
		May-Aug	– 0.075	0.208	**0.417***	**0.433***	**0.752***
			(0.716)	(0.309)	**(0.034)**	**(0.027)**	**(0.000)**
7	*Juniperus*	May	– 0.285	0.034	**– 0.371#**	**0.406***	**0.499***
	przewalskii		(0.157)	(0.868)	**(0.062)**	**(0.040)**	**(0.010)**
		Jun	0.156	0.101	0.023	**0.468***	**0.415***
			(0.448)	(0.623)	(0.912)	**(0.016)**	**(0.035)**
		Jul	– 0.147	– 0.110	– 0.087	– 0.099	**0.444***
			(0.473)	(0.594)	(0.673)	(0.630)	**(0.023)**
		Aug	– 0.124	0.154	– 0.032	– 0.048	**0.390***
			(0.546)	(0.453)	(0.876)	(0.815)	**(0.049)**
		May-Jun	0.006	0.100	– 0.281	**0.503***	**0.441***
			(0.977)	(0.628)	(0.164)	**(0.009)**	**(0.024)**
		Jun-Aug	– 0.061	0.082	0.004	0.310	**0.285**
			(0.767)	(0.692)	(0.986)	(0.123)	**(0.158)**
		May-Aug	– 0.076	0.140	– 0.130	**0.415***	0.302
			(0.712)	(0.495)	(0.528)	**(0.035)**	(0.134)
8	*Juniperus*	May	0.028	**0.417***	– 0.178	0.277	**0.592***
	przewalskii		(0.893)	**(0.034)**	(0.383)	(0.171)	**(0.001)**
		Jun	0.076	0.250	**0.384#**	0.125	**0.470***
			(0.711)	(0.218)	**(0.053)**	(0.542)	**(0.016)**

		Jul	– 0.104	– 0.034	0.249	– 0.069	**0.437***
			(0.614)	(0.869)	(0.220)	(0.736)	**(0.026)**
		Aug	**– 0.421***	**0.446***	– 0.268	0.189	**0.564***
			(0.032)	**(0.022)**	(0.185)	(0.355)	**(0.003)**
		May-Jun	0.111	0.296	0.126	0.214	**0.534***
			(0.590)	(0.142)	(0.538)	(0.294)	**(0.005)**
		Jun-Aug	– 0.142	0.279	0.126	0.084	**0.442***
			(0.487)	(0.168)	(0.538)	(0.682)	**(0.024)**
		May-Aug	– 0.107	**0.345#**	0.013	0.145	**0.482***
			(0.601)	**(0.084)**	(0.948)	(0.480)	**(0.013)**
9	*Juniperus przewalskii*	May	0.137	0.104	– 0.297	0.249	0.301
			(0.576)	(0.672)	(0.217)	(0.304)	(0.211)
		Jun	– 0.285	0.206	0.280	0.094	0.339
			(0.237)	(0.397)	(0.246)	(0.701)	(0.156)
		Jul	**– 0.406#**	0.378	0.234	– 0.062	0.298
			(0.084)	(0.110)	(0.335)	(0.802)	(0.216)
		Aug	0.086	0.248	0.057	– 0.148	0.042
			(0.727)	(0.306)	(0.817)	(0.545)	(0.865)
		May-Jun	– 0.302	0.384	– 0.102	0.219	**0.412#**
			(0.209)	(0.105)	(0.678)	(0.368)	**(0.080)**
		Jun-Aug	– 0.250	**0.451#**	0.223	– 0.083	0.219
			(0.302)	**(0.053)**	(0.359)	(0.735)	(0.368)
		May-Aug	– 0.274	**0.563***	0.104	0.022	0.292
			(0.256)	**(0.012)**	(0.670)	(0.928)	(0.226)
10	*Picea likiangensis* var. *balfouriana*	May	0.350	– 0.083	0.081	– 0.026	**0.479***
			(0.119)	(0.721)	(0.726)	(0.910)	**(0.028)**
		Jun	**0.410#**	0.055	0.337	**0.441***	**0.614***
			(0.065)	(0.813)	(0.135)	**(0.045)**	**(0.003)**

		Jul	– 0.311	0.097	– 0.194	– 0.191	**0.676***
			(0.170)	(0.677)	(0.399)	(0.408)	**(0.001)**
		Aug	– 0.262	**0.423#**	– 0.193	0.177	**0.637***
			(0.252)	**(0.056)**	(0.403)	(0.442)	**(0.002)**
		May-Jun	0.367	0.034	0.240	0.274	**0.449***
			(0.101)	(0.885)	(0.294)	(0.229)	**(0.041)**
		Jun-Aug	0.032	**0.375#**	0.026	0.318	**0.489***
			(0.891)	**(0.094)**	(0.911)	(0.160)	**(0.024)**
		May-Aug	0.193	0.354	0.118	**0.374#**	0.362
			(0.401)	(0.115)	(0.610)	**(0.095)**	(0.107)
11	*Abies*	May	0.026	– 0.045	– 0.099	– 0.078	**0.901***
	faxoniana		(0.904)	(0.835)	(0.647)	(0.717)	**(0.000)**
		Jun	– 0.092	– 0.214	– 0.112	0.000	**0.879***
			(0.671)	(0.314)	(0.603)	(1.000)	**(0.000)**
		Jul	– 0.110	0.087	– 0.020	– 0.155	**0.858***
			(0.610)	(0.685)	(0.926)	(0.469)	**(0.000)**
		Aug	0.014	0.092	– 0.222	0.147	**0.840***
			(0.947)	(0.670)	(0.296)	(0.492)	**(0.000)**
		May-Jun	0.000	– 0.169	– 0.073	– 0.007	**0.887***
			(0.998)	(0.431)	(0.733)	(0.975)	**(0.000)**
		Jun-Aug	– 0.065	– 0.042	– 0.176	– 0.065	**0.830***
			(0.763)	(0.846)	(0.411)	(0.763)	**(0.000)**
		May-Aug	– 0.075	– 0.016	– 0.158	– 0.083	**0.826***
			(0.728)	(0.941)	(0.462)	(0.698)	**(0.000)**
12	*Abies*	May	– 0.133	0.381	**0.668***	– 0.377	**0.884***
	forrestii		(0.612)	(0.132)	**(0.003)**	(0.135)	**(0.000)**
		Jun	0.042	0.047	0.231	0.205	**0.780***
			(0.873)	(0.856)	(0.372)	(0.430)	**(0.000)**

		Jul	– 0.403	0.395	– 0.385	0.331	**0.906***
			(0.109)	(0.117)	(0.127)	(0.195)	**(0.000)**
		Aug	0.125	**0.648***	**0.511***	**0.550***	**0.808***
			(0.632)	**(0.005)**	**(0.036)**	**(0.022)**	**(0.000)**
		May-Jun	0.010	0.088	**0.474#**	0.058	**0.796***
			(0.970)	(0.738)	**(0.055)**	(0.824)	**(0.000)**
		Jun-Aug	– 0.031	0.293	0.162	0.313	**0.747***
			(0.905)	(0.254)	(0.535)	(0.221)	**(0.001)**
		May-Aug	0.200	0.144	**0.550***	0.404	**0.720***
			(0.442)	(0.581)	**(0.022)**	(0.108)	**(0.001)**
13	*Picea likiangensis*	May	– 0.104	0.016	0.005	– 0.012	0.394
			(0.701)	(0.953)	(0.986)	(0.965)	(0.131)
		Jun	**– 0.443#**	**0.449#**	**– 0.659***	**0.585***	**0.749***
			(0.086)	**(0.081)**	**(0.005)**	**(0.017)**	**(0.001)**
		Jul	– 0.080	0.296	– 0.129	– 0.072	**0.493#**
			(0.769)	(0.266)	(0.634)	(0.790)	**(0.053)**
		Aug	– 0.393	0.186	– 0.011	0.360	**0.477#**
			(0.132)	(0.490)	(0.968)	(0.171)	**(0.062)**
		May-Jun	– 0.247	0.109	– 0.253	0.259	**0.507***
			(0.356)	(0.689)	(0.344)	(0.332)	**(0.045)**
		Jun-Aug	– 0.340	0.385	– 0.209	0.210	**0.538***
			(0.198)	(0.141)	(0.437)	(0.436)	**(0.032)**
		May-Aug	– 0.403	0.363	– 0.196	0.304	**0.533***
			(0.121)	(0.167)	(0.467)	(0.253)	**(0.033)**

Supplementary Table 6. Partial correlation coefficients of multiple linear regressions for relationships of 10-year moving averages of tree-ring width index to previous and current year's early-season (May to June) mean minimum temperature (PT, T) and precipitation (PP, P) and the atmospheric CO_2 concentration, based on the chronological data (since 1986) of tree-ring width index across 8 tree species and 13 treeline sites on the Tibetan Plateau collected from this study and the literature. Detailed sites information is found in Supplementary Table 1. The statistical significance is estimated by two-tailed t-test with no adjustment for multiple comparisons. *P* values are shown in parentheses. Significant level: #*P* <0.10, **P* <0.05.

Site ID	Species	Partial correlation coefficient				
		PT	PP	T	P	CO_2
1	*Abies georgei* var.	– 0.244	0.145	**– 0.408#**	0.328	**0.893***
	smithii	(0.314)	(0.552)	**(0.083)**	(0.170)	**(0.000)**
2	*Juniperus saltuaria*	– 0.022	0.061	– 0.292	0.265	**0.939***
		(0.928)	(0.804)	(0.225)	(0.274)	**(0.000)**
3	*Juniperus tibetica*	0.354	– 0.289	– 0.032	0.354	**0.679***
		(0.350)	(0.450)	(0.935)	(0.351)	**(0.044)**
4	*Juniperus tibetica*	0.425	– 0.088	– 0.338	– 0.179	**0.989***
		(0.168)	(0.787)	(0.283)	(0.578)	**(0.000)**
5	*Juniperus tibetica*	0.296	0.290	**0.722***	– 0.607	**0.947***
		(0.439)	(0.448)	**(0.028)**	(0.083)	**(0.000)**
6	*Juniperus przewalskii*	0.123	– 0.186	– 0.036	**0.438#**	**0.953***
		(0.639)	(0.475)	(0.891)	**(0.079)**	**(0.000)**
7	*Juniperus przewalskii*	– 0.200	0.240	– 0.247	0.345	**0.786***
		(0.441)	(0.353)	(0.339)	(0.175)	**(0.000)**
8	*Juniperus przewalskii*	0.243	**0.726***	– 0.049	– 0.080	**0.892***
		(0.348)	**(0.001)**	(0.852)	(0.761)	**(0.000)**
9	*Juniperus przewalskii*	– 0.200	0.303	0.054	0.101	**0.728***
		(0.579)	(0.395)	(0.883)	(0.781)	**(0.017)**

10	*Picea likiangensis*	**0.818***	**– 0.503#**	**0.687***	– 0.016	**0.868***
	var. *balfouriana*	**(0.001)**	**(0.096)**	**(0.014)**	(0.960)	**(0.000)**
11	*Abies faxoniana*	– 0.043	– 0.426	– 0.193	**0.483#**	**0.877***
		(0.879)	(0.113)	(0.490)	**(0.068)**	**(0.000)**
12	*Abies forrestii*	**0.688#**	– 0.393	**0.788***	– 0.160	**0.927***
		(0.059)	(0.335)	**(0.020)**	(0.706)	**(0.001)**
13	*Picea likiangensis*	– 0.015	– 0.339	0.206	– 0.335	0.281
		(0.975)	(0.456)	(0.768)	(0.462)	(0.542)

References of data source in Supplementary Table 1:

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