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Supplement of

Multi-century mean summer temperature variations in the Southern Rhaetian Alps reconstructed from *Larix decidua* blue intensity data

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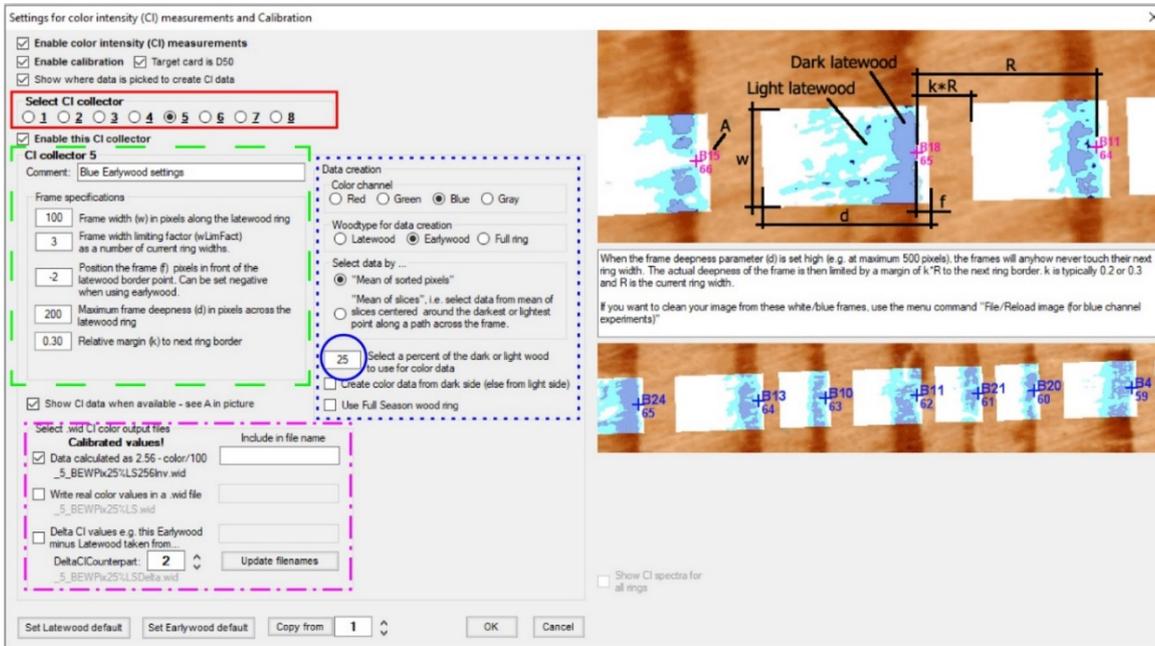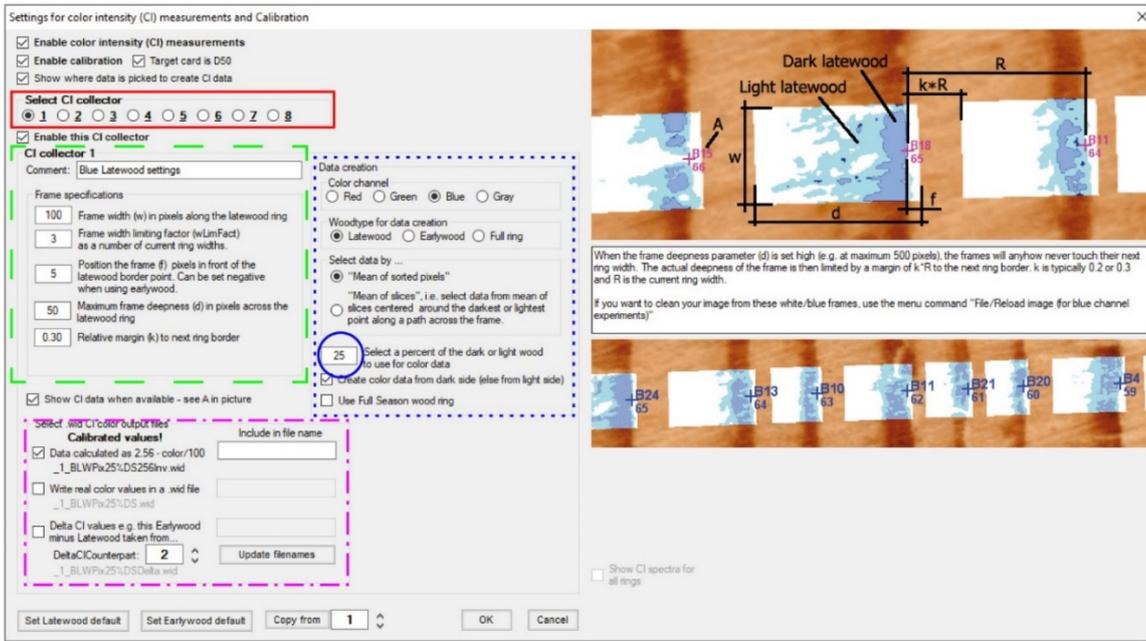
Figure S1: Screenshots of CooRecorder software. Solid red rectangle: different collectors that give the possibility to save several exporting settings. Dashed green rectangle: setting of the frame on which BI is measured; the meaning of the parameter is reported in the picture on the right. Dotted blue rectangle: settings for the BI data creation; blue solid circle: percentage of the pixel considered for the BI. Dash-dotted magenta rectangle: Setting for the format of the output data. In this case, the BI is inverted. Upper image: parameter for Latewood BI (LWBI); lower image: selected parameters for Earlywood BI (EWBI). CooRecorder 9.5 software (Cybis 2020 – http://www.cybis.se/forfun/dendro/index.htm, last access: 26 February 2025).
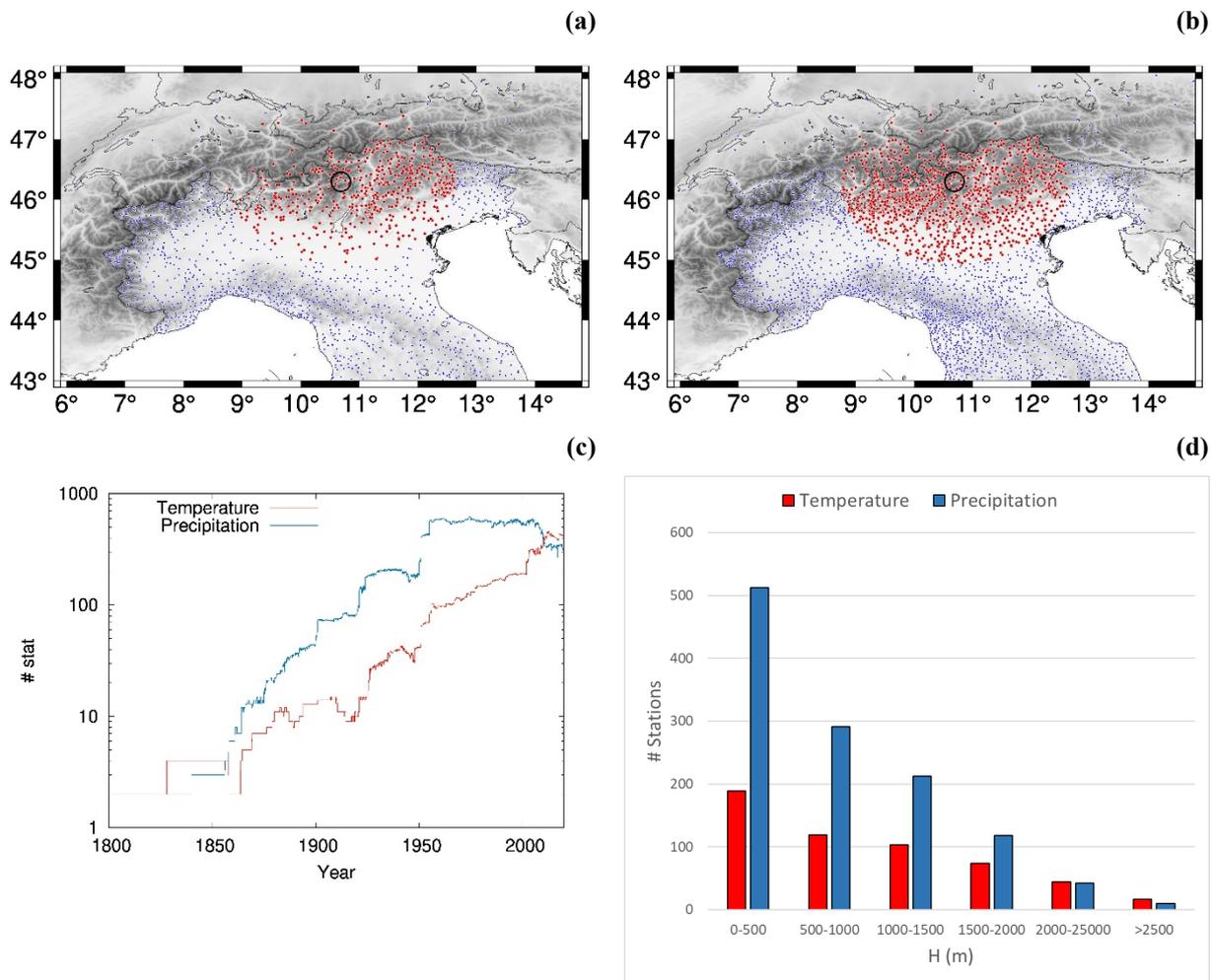
Figure S2: a) Spatial distribution of temperature stations. b) Spatial distribution of precipitation stations. Red dots indicate stations within 150 km of the centroid of the sampling sites (black circle). c) Temporal evolution of available stations within 150 km of the centroid of the sampling sites (red dots in panels a and b). d) Station distribution versus elevation.
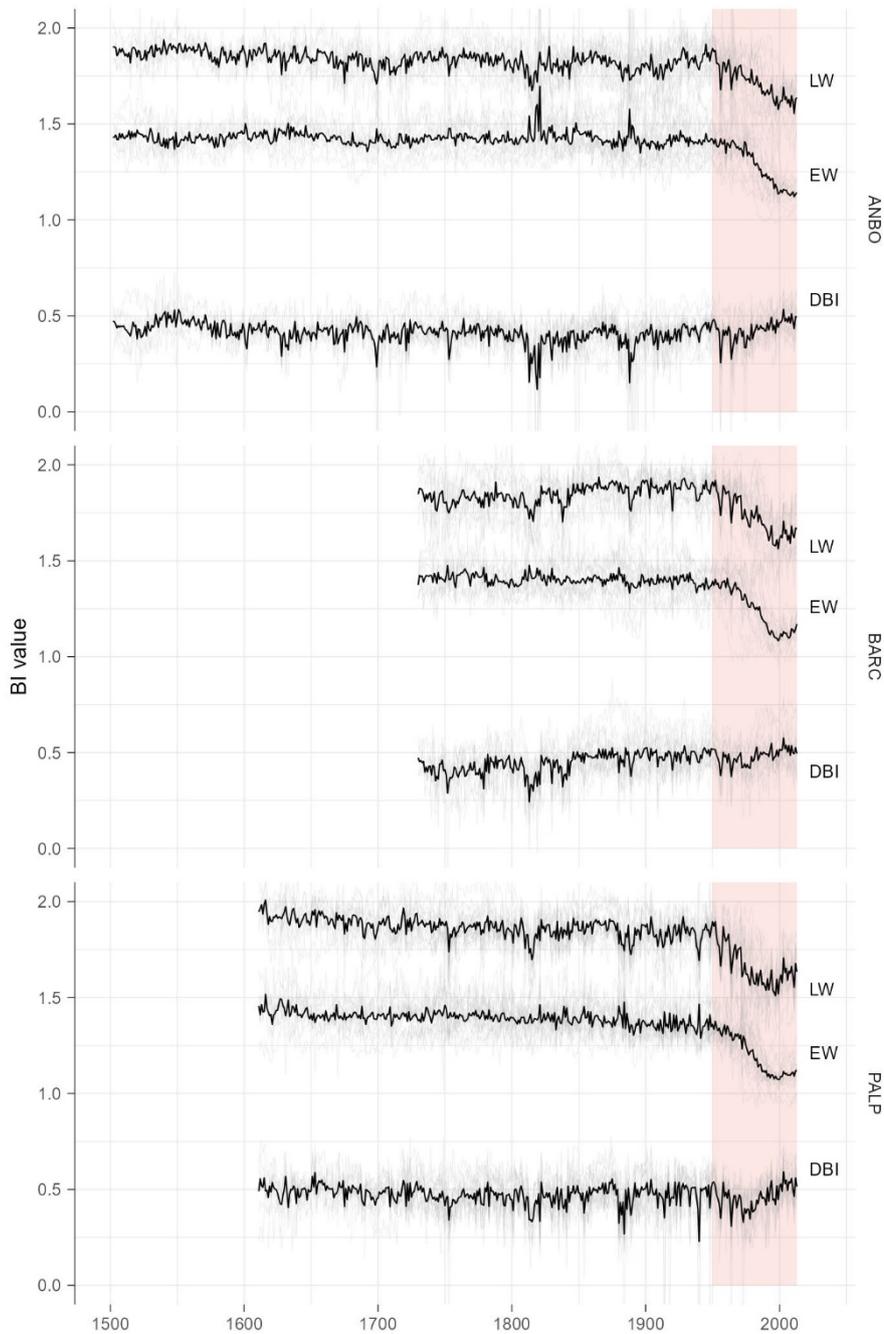
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Figure S3: Mean raw BI series of latewood (LW), earlywood (EW) and DBI (delta) (thick solid black line). Solid grey thin lines identify the raw individual series. The red area identifies the portion of the series where the transition from heartwood to sapwood occurs.

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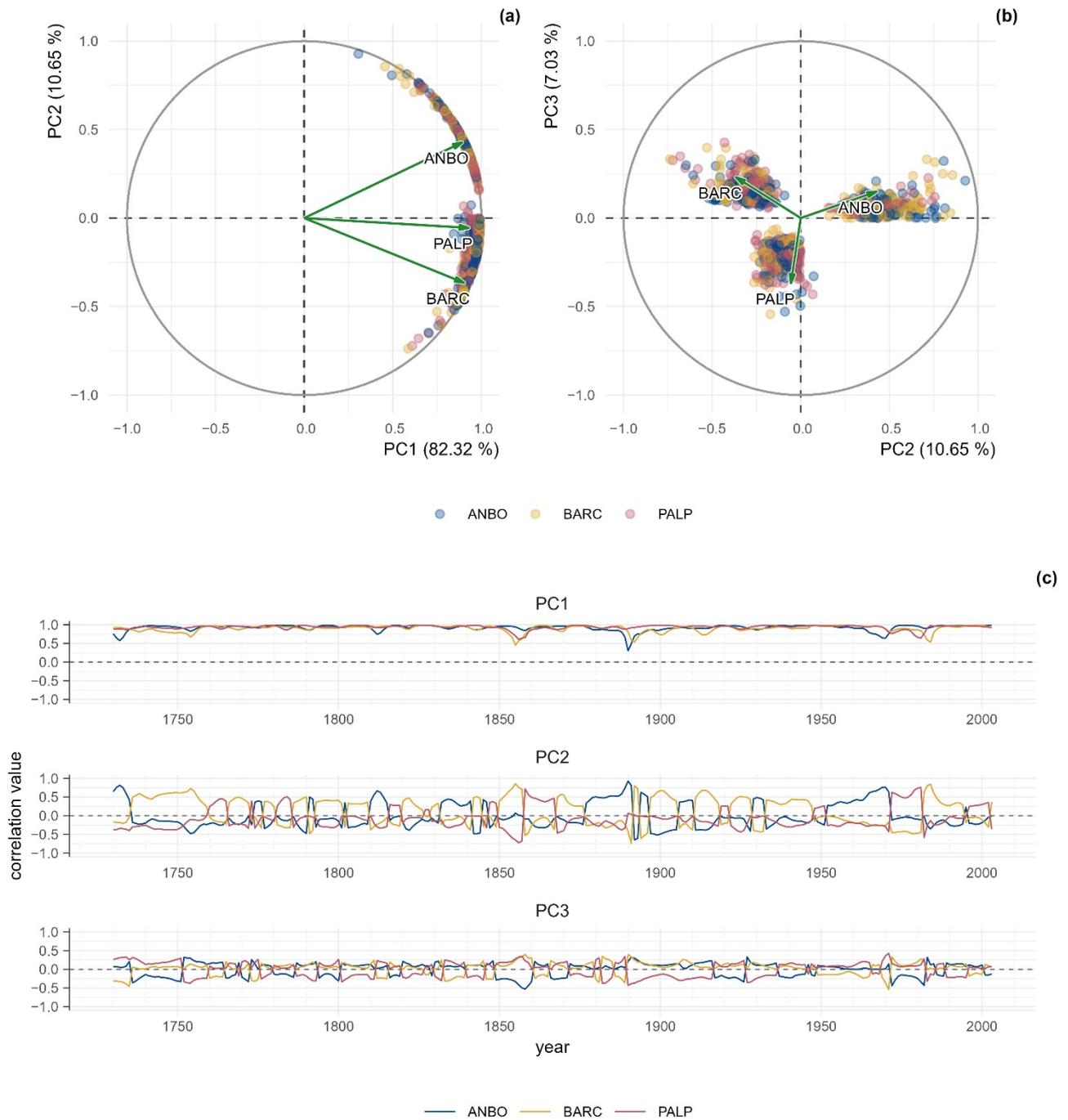
Figure S4: Evolutionary Principal Component Analysis (EPCA; Camiz and Spada, 2023) for PC1 and 2 (a) and PC2 and 3 (b). Correlation value between DBI chronologies and the principal components (c). Green arrows in (a) and (b) represent the PC coordinates for the entire considered period (1731–2013).
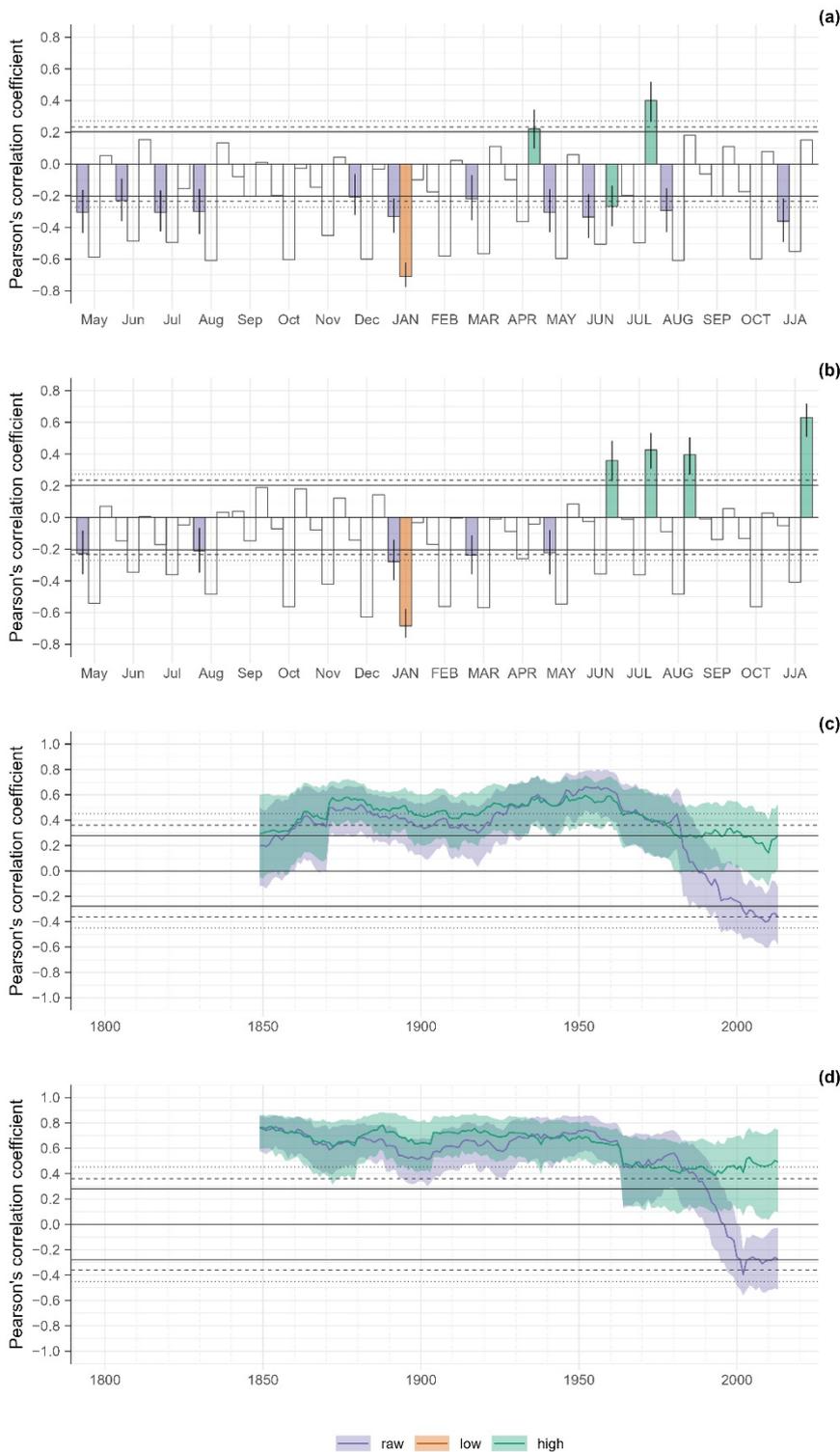
Figure S5: Pearson's correlation coefficient between EWBI (a) or LWBI (b) PC1 (ANBO+BARC+PALP) and the mean temperature for the period of 1800–2013. The coloured bars indicate that the correlation values are significant at least at the 0.05 level. White bars indicate not significant values. The solid black vertical line indicates the 95 % confidence interval of the BI correlations. All capitalized month abbreviations indicate the current year. Pearson's moving correlation coefficient (50-year window, 1-year step, right aligned) between EWBI PC1 (ANBO+BARC+PALP) and the current July mean temperature (c) or between LWBI PC1 (ANBO+BARC+PALP) and the JJA mean temperature (d). The shaded area represents the 95 % confidence interval. The solid, dashed and dotted black lines represent significance at the 0.05, 0.01 and 0.001 levels, respectively. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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ANBO

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	JJA
hig											.51	.29	.34						.62
low	.74	.89	.91	.91	.71	.69	.66		.74	.75	.75	.77	.76	.90	.92	.92	.72	.69	.94
raw	.31	.37	.44	.42	.37	.32	.29	.30	.28		.23	.23	.37	.66	.59	.60	.29		.80

BARC

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	JJA
hig											.43	.27	.32						.55
low			.70	.68										.71	.69				.70
raw		.23	.36	.32	.30							.21	.49	.47	.49	.25			.63

PALP

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	JJA
hig					.21								.47		.33				.54
low																			
raw		.21	.28		.27	.21							.51	.35	.41				.56

Pearson's correlation coefficient

-1.0   -0.5   0.0   0.5   1.0

35   Figure S6: Pearson's correlation values between DBI site chronologies and CRU TS 4.07 mean temperature dataset for the period 1901–2013. Numbers indicate significant values at 0.05 level.

Tmin

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	JJA
hig														.48	.30	.40			.60
low		.75	.75	.68										.77	.76	.69			.76
raw	.22	.31	.40	.34	.32	.24	.24						.25	.59	.54	.55	.24		.70

Tmax

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	JJA
hig														.51	.24	.32			.58
low		.74	.76	.78						.68				.75	.76	.79			.80
raw	.23	.28	.36	.30	.33	.26	.21	.21					.28	.59	.46	.50	.22		.70

Prec

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	JJA
hig														.28					
low																			
raw																			

Pearson's correlation coefficient

40   Figure S7: Pearson's correlation coefficient between DBI PC1 (ANBO+BARC+PALP) and CRU TS 4.07 climatic parameters for the period 1901–2013. Tmin: monthly mean minimum temperature; Tmax: monthly mean maximum temperature; Prec: monthly precipitation sum. Numbers indicate significant values at 0.05 level.

45 Figure S8: Pearson's spatial correlation coefficient between DBI PC1 (ANBO+BARC+PALP) and the CRU TS4.07 mean aggregated JJA temperature for the period 1901–2013 for the raw data and selected time windows. The solid lines represent significance levels of 0.05. The white dots represent the locations of the sampling stands.
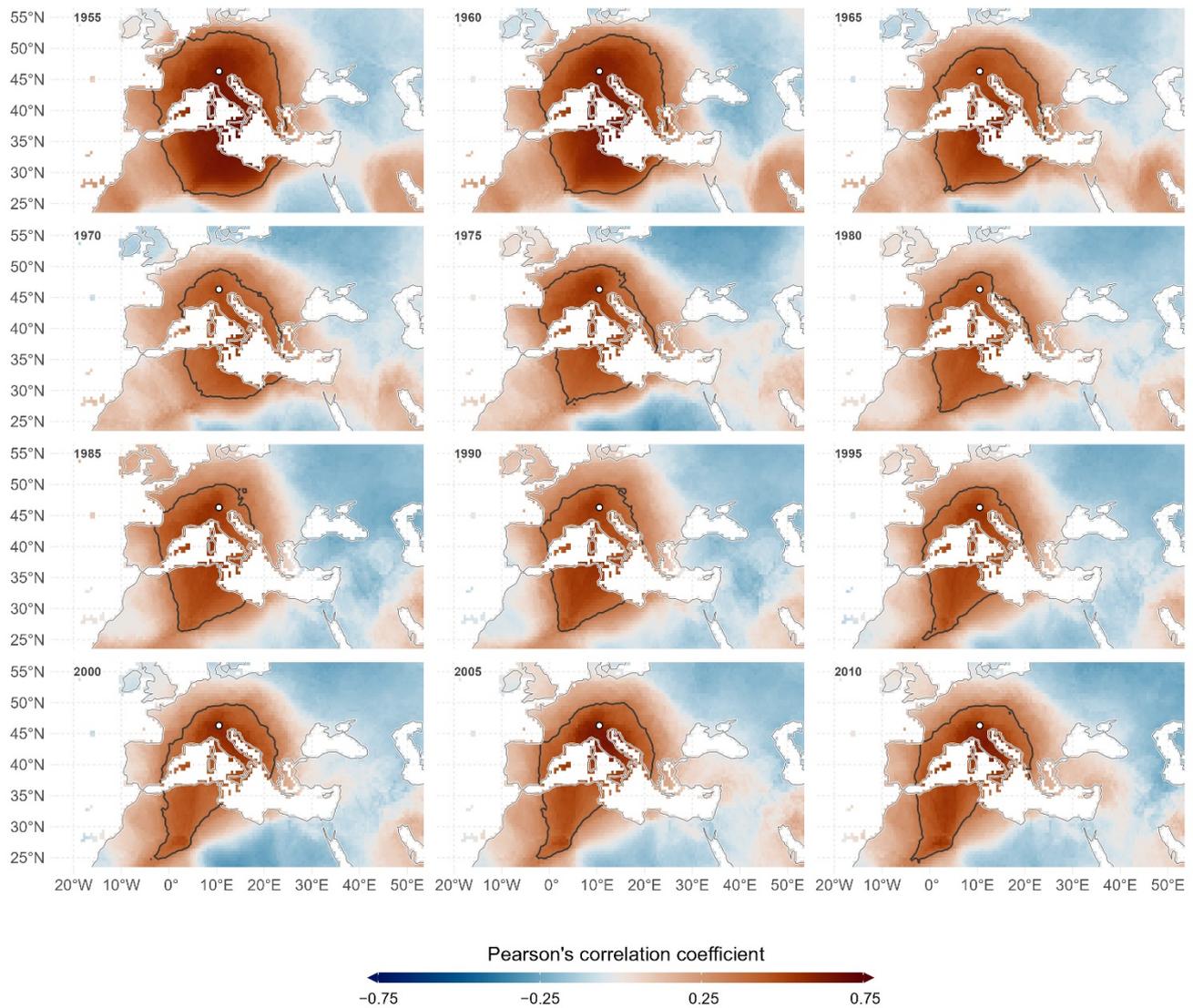
Figure S9: Pearson's spatial correlation coefficient between DBI PC1 (ANBO+BARC+PALP) and the CRU TS4.07 mean
50 aggregated JJA temperature for the period 1901–2013 for the high-frequency domain and selected time windows. The solid
lines represent significance levels of 0.05. The white dots represent the locations of the sampling stands.

Table S1: Pearson's correlation values between the first principal component (PC1) of the site chronologies EWBI, LWBI, and DBI values and the mean temperature of current June, July, August, and JJA. *Italic* identifies values not significant at 0.05 level. Further details in Fig. S3 in the Supplementary Material.

	EWBI			LWBI			DBI		
	raw	low	high	raw	low	high	raw	low	High
JUN	−0.34	−0.50	−0.26	*−0.03*	−0.36	0.36	0.60	0.74	0.51
JUL	*−0.20*	−0.50	0.40	*−0.01*	−0.36	0.43	0.51	0.76	0.28
AUG	−0.30	−0.61	*0.18*	*−0.09*	−0.49	0.39	0.53	0.74	0.36
JJA	−0.36	−0.55	*0.16*	*−0.06*	−0.41	0.63	0.71	0.77	0.62

Table S2: Explained variances in the calibration periods and statistical parameters of the CCV and BTFS procedures between PC1 (ANBO+PALP) and the JJA mean temperature. Italicized values identify parameters that do not pass the statistical tests (at the 95% level, when applicable).

Cal. Period		R^2_{cal}[1]	DW	CCV[1]		BTFS[2]		
				RE	CE	Intercept ratio	Slope ratio	R² ratio
Raw	1800–1906	0.51±0.07	1.81	0.47±0.04	*−0.12±0.10*	*0.890÷0.937*	0.690÷1.256	0.686÷1.713
	1907–2013	0.47±0.08	*1.26*	0.42±0.03	*−0.09±0.13*			
Low	1800–1906	0.67±0.06	*0.04*	0.66±0.03	*−0.91±0.10*	*0.902÷0.929*	0.676÷1.026	0.879÷1.529
	1907–2013	0.56±0.05	*0.01*	0.49±0.02	*−1.77±0.47*			
High	1800–1906	0.44±0.08	2.25	0.36±0.05	0.26±0.04	−11.488÷11.178	0.722÷1.743	0.772÷2.743
	1907–2013	0.31±0.08	2.18	0.28±0.05	0.38±0.06			

[1] We report 1 standard deviation as a measure of uncertainty. [2] Confidence intervals at 95% are reported for BTSF parameters. For a detailed description of the BTFS parameters, please refer to Buras et al. (2017).

Table S3: Explained variances in the calibration periods and statistical parameters of the CCV and BTFS procedures between ANBO and the JJA mean temperature. Italicized values identify parameters that do not pass the statistical tests (at the 95% level, when applicable).

Cal. period		R^2_{cal}[1]	DW	CCV[1]		BTFS[2]		
				RE	CE	Intercept ratio	Slope ratio	R² ratio
Raw	1800–1906	0.48±0.07	1.83	0.47±0.01	0.32±0.11	−5.268÷4.159	0.603÷1.019	0.514÷1.059
	1907–2013	0.63±0.06	1.71	0.62±0.01	0.24±0.08			
Low	1800–1906	0.67±0.06	*0.03*	0.66±0.10	0.17±0.11	*−0.374÷0.265*	*0.606÷0.794*	*0.603÷0.881*
	1907–2013	0.88±0.02	*0.05*	0.87±0.00	0.10±0.14			
High	1800–1906	0.40±0.08	2.07	0.37±0.01	0.35±0.02	0.576÷1.424	0.580÷1.435	0.569÷2.005
	1907–2013	0.37±0.08	2.16	0.35±0.02	0.36±0.03			

[1] We report 1 standard deviation as a measure of uncertainty. [2] Confidence intervals at 95% are reported for BTSF parameters. For a detailed description of the BTFS parameters, please refer to Buras et al. (2017).

References

Buras, A., Zang, C., and Menzel, A.: Testing the stability of transfer functions, Dendrochronologia, 42, 56–62, https://doi.org/10.1016/j.dendro.2017.01.005, 2017.

Camiz, S. and Spada, F.: Checking the stability of correlation of chronologies over time: an example on Pinus pinea L. rings widths, Ann. Silvic. Res., 49, 13–23, https://doi.org/10.12899/asr-2455, 2023.