## SUPPLEMENTARY MATERIALS

High-resolution temperature variability reconstructed
# from black pine tree ring densities in southern Spain

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Table S1 MXD site chronology statistics. The C07 data were sampled in 2007 and the MXD data measured at the Institute of Forest Utilization and Forest Technology in Tharandt (Germany). The C15a and C15b data were sampled in 2015 at to nearby locations in slightly different elevations and the MXD data were measured at the Department of Geography in Mainz (Germany).

|	C07	C15a	C15b
Elevation [m a.s.l.]	1950-2000	1950-2000	1800-1850
Chronology period	1196-2006 CE	1209-2014 CE	1268-2014 CE
No. of trees and radii	16 | 19	23 | 45	12 | 24
Mean series length [yrs.]	404	318	352
Gaps [%]	4.4	2.8	0.6
Average MXD [g/cm^3]	0.88	0.81	0.87
Interseries correlation	0.25	0.19	0.19
Interseries correl. (TRW)	0.44	0.37	0.4
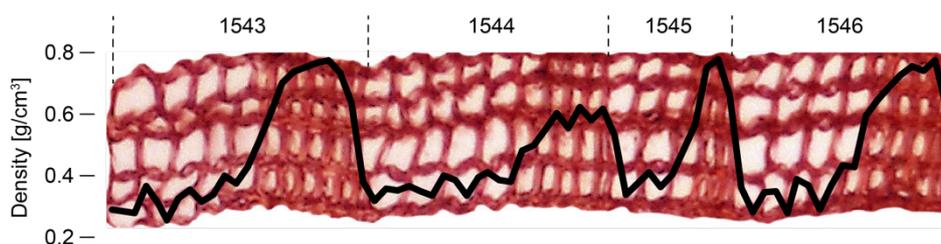
Figure S1 High-resolution wood density profile (black curve) of the 1543-1546 CE tree-rings of a *Pinus nigra* from Cazorla national park. The earlywood towards the left of each ring is characterized by large tracheid cells and thin cell walls. Wood density increased to values > 0.4 g/cm^3 in the latewood, towards the right, as a function of smaller (and tangentially compressed) cells and thicker cell walls. The peak value typically reached towards the termination of a ring, the maximum latewood density (MXD), is substantially lower in 1544 (< 0.6 g/cm^3), even though the ring was fairly wide in that year (see the dashed lines at the top). 1544 is one of the coldest reconstructed years in the Cazorla national park.
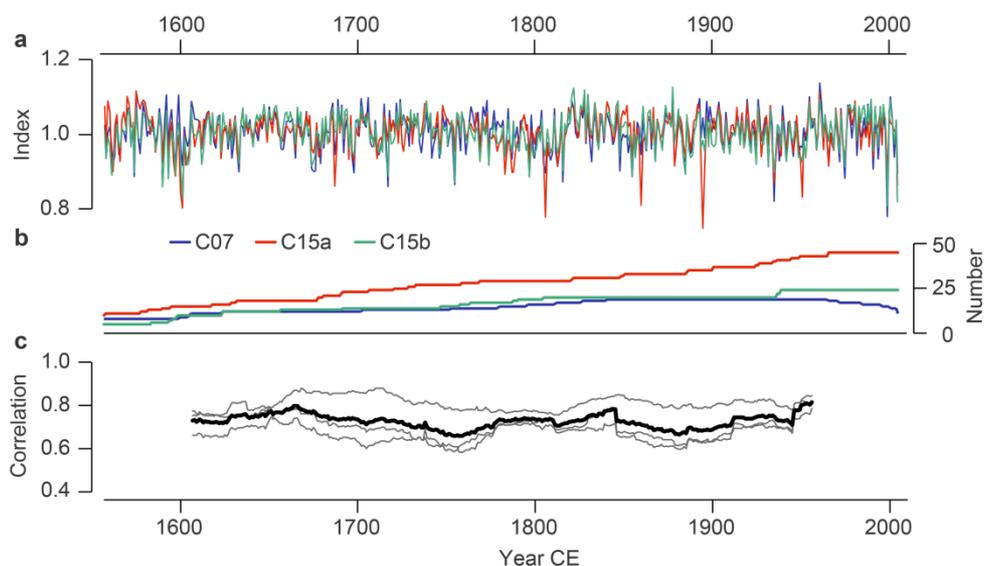
Figure S2 a, 300-year spline detrended MXD site chronologies from the 2007 and 2015 sampling campaigns over the common 1557-2006 period. **b**, Site replication curves showing the changing numbers of MXD series combined in the chronologies. **c**, 100-year running inter-series correlations between the single site chronologies (thin curves) and their mean (bold curve).
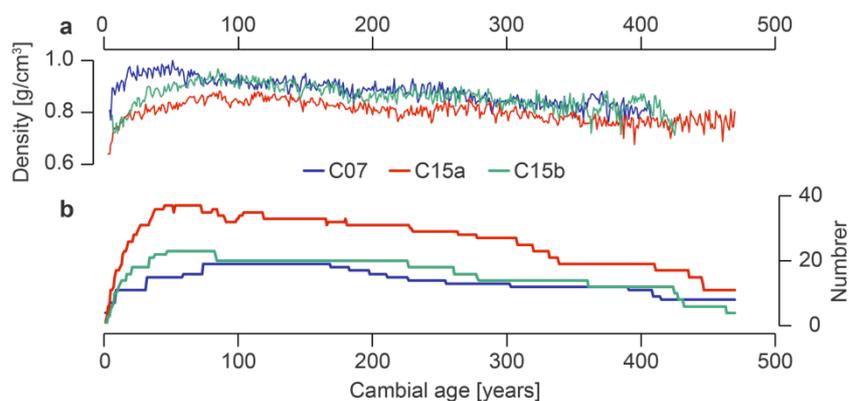

Figure S3 MXD site regional curves (**a**) shown together with MXD series replication curves (**b**) over the first 500 years of biological age.
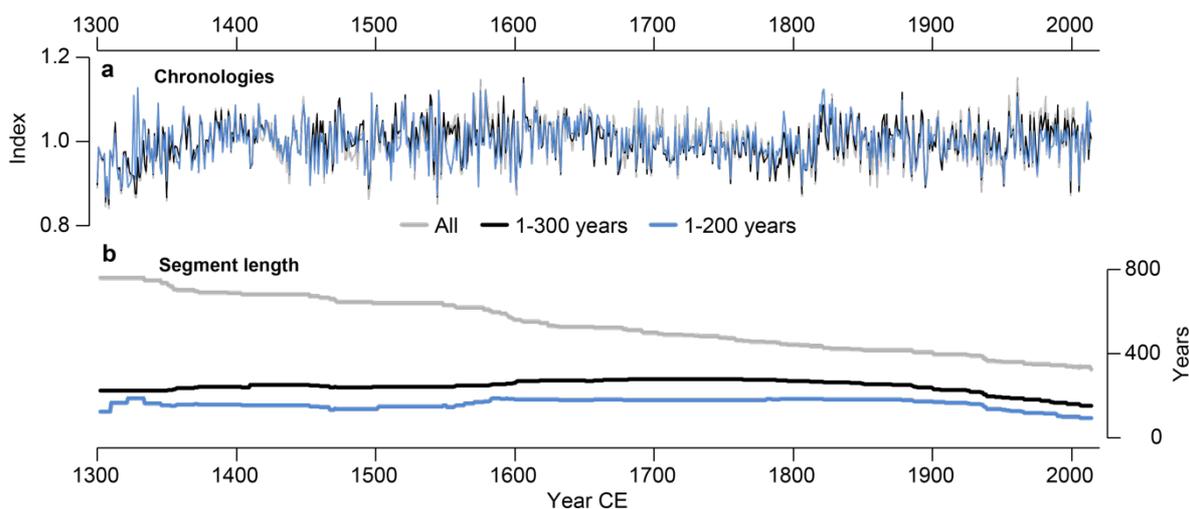
Figure S4 Cazorla MXD chronologies (**a**) shown together with the segment length curves for all, the 1-300 and 1-200 age band data (**b**).
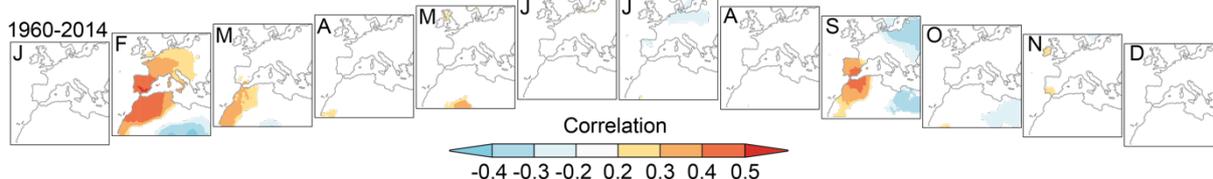
Figure S5 Monthly correlation patterns between the ABC300 MXD chronology and CRU (TS4.03) gridded temperature data over the 1960-2014 period.
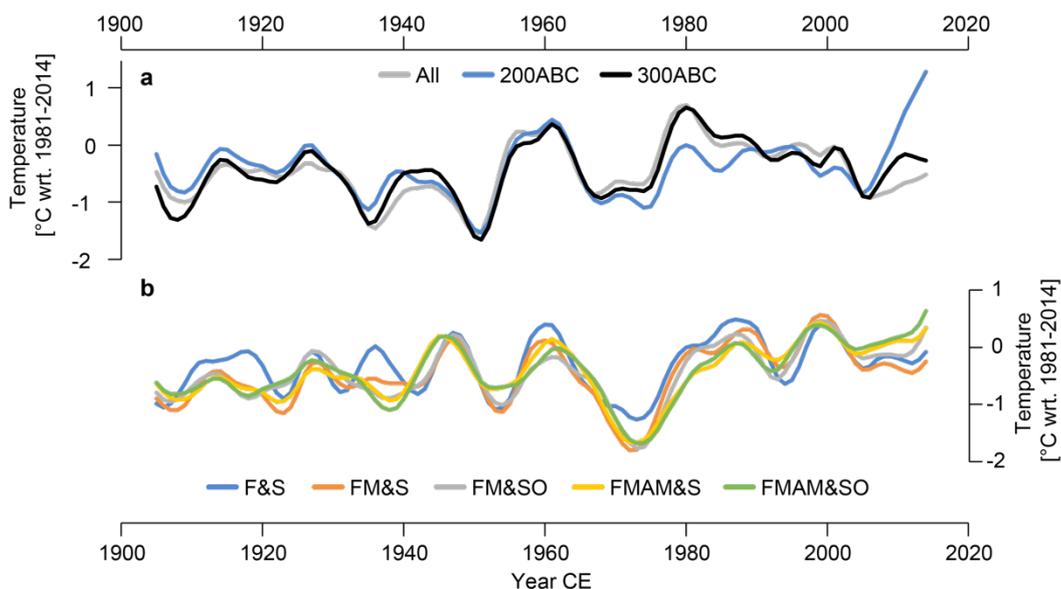
Figure S6 Lower frequency proxy-target coherence. 30-year smoothed MXD chronologies (**a**) shown together with the smoothed seasonal temperature means (**b**) over the common 1905-2014 period.
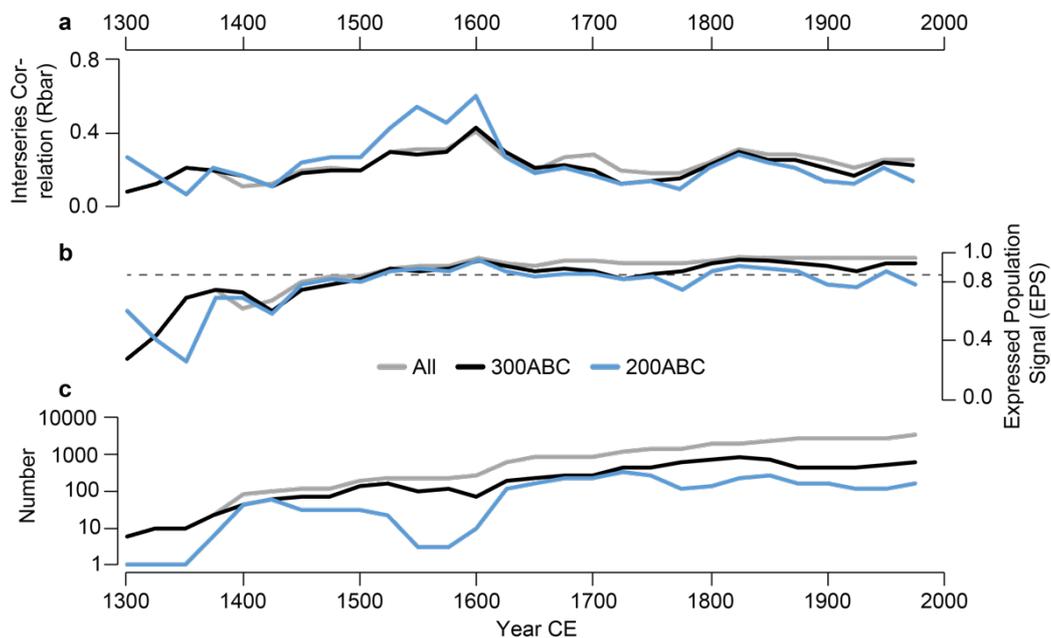
Figure S7 Running interseries correlations (**a**), Expressed Population Signals (**b**), and numbers of correlation pairs (**c**) of the All, 300ABC, and 200ABC MXD chronologies calculated in a running 50-year window at an offset of 25 years.