Appendix A – Details on Individual Tree-Ring Reconstructions and CMIP5 models

TR series code (see Table 1)	Brief description and specific original reference
North America	
NTR	MXD chronology: STD detrending – see D'Arrigo et al. (2004). RW data for this region used in DWJ06, not used for this location due to poor calibration.
GOA	RW based reconstruction: RCS detrending – see Wiles et al. (2014) – update of chronology used in DWJ06.
WRAx	MXD: STD detrending. Same version used in Wilson et al. (2007 – Appendix A) – original reference Davi et al. (2003). RW data for this region used in DWJ06, not used for this location due to poor calibration.
FIRT	MXD chronology: RCS-SF detrending – see Anchukaitis et al. (2013)
YUS	RW based reconstruction: STD detrending. Same version used in Wilson et al. (2007 – Appendix A) – original reference Youngblut and Luckman (2007)
YUN	RW based reconstruction: STD detrending. Same version used in Wilson et al. (2007 – Appendix A) – original reference Szeicz and MacDonald (1995)
IBC	RW, MXD and BI based reconstruction: STD detrending – see Wilson et al. (2014). BI - Blue Intensity is a relatively new tree-ring parameter (McCarroll et al. 2002; Campbell et al. 2011; Björklund et al. 2014; Rydval et al. 2014) that utilises the intensity of the reflectance of blue light of the TR latewood to derive an estimate of lignin content in latewood cells. As lignin content is reflected by density, raw BI and MXD are inversely correlated and both calibrate similarly to summer temperatures.
ICE	RW and MXD based reconstruction: RCS detrending – Same version used in DWJ06 – original reference Luckman and Wilson (2005)
IDA	RW based reconstruction: STD detrending. Same version used in Wilson et al. (2007 – Appendix A) – original reference Biondi et al. (1999)
COP	MXD chronology: RCS-SF detrending – see Anchukaitis et al. (2013)
THE	MXD chronology: RCS-SF detrending – see Anchukaitis et al. (2013)
QUEx	MXD chronology: RCS detrending – see Schneider et al. (2015). Period used for chronology is where replication ≥ 5 series.
QUEw	RW based reconstruction: RCS detrending – see Gennaretti et al. (2014).
NQU	RW composite chronology: STD detrending. Same version used in Wilson et al. (2007 – Appendix A) – original reference Payette (2007).
LAB	RW and MXD based reconstruction: RCS (RW), STD (MXD) detrending. RW data (D'Arrigo

	et al. 2003 – used in DWJ06) and MXD data (D'Arrigo et al. 2013) were combined using multiple-regression to derive a locally optimised calibration estimate of JJA temperatures.
Eurasia	
SCOT	RW and BI based reconstruction: RCS-SF detrending. Band-pass fusion of RW (low frequency) and BI (high frequency) – original reference Rydval et al. (submitted). For more information about BI, see IBC description above.
PYR	MXD based reconstruction: RCS detrending – see Dorado-Linan et al. (2012).
ALPS	MXD based reconstruction: RCS detrending - see Büntgen et al. (2006).
TYR	MXD chronology: RCS detrending – see Schneider et al. (2015). Period used for chronology is where replication ≥ 5 series.
JAEM	MXD based reconstruction: RCS detrending - see Zhang et al. (2015).
TAA	MXD composite chronology: RCS detrending – mean composite chronology of 3 chronologies (Tjeggelvas, Arjeplog and Ammarnäs). See Linderholm et al. (2014). Each composite chronology was normalised to z-scores over the period 1750-1950 and averaged while variance was stabilised to ensure no heteroscedasticity biases due to changing number of records using a modified equation from Osborn et al. (2007) – Appendix C1.
EFmean	MXD composite reconstruction: RCS detrending – mean of two northern Scandinavia studies to derive regional scale estimates of JJA mean temperatures. See Esper et al (2014) and Matskovsky and Helama (2014). These studies were used as they reflect, due to the high number of tree-ring records used, the most comprehensive compilation of available MXD data for this region. As they empirically could not be distinguished, a simple average of the two was made.
FORF	MXD chronology: RCS detrending – MXD data as used in McCarroll et al. (2013).
TAT	RW based reconstruction: RCS detrending – see Büntgen et al. (2013).
MOG	MXD based reconstruction: RCS detrending – see Klesse et al. (2014).
SFIN	MXD based reconstruction: RCS detrending – see Helama et al. (2014).
KOL	RW and BI reconstruction: RCS detrending. RW and BI chronologies were combined using multiple-regression to derive a locally optimised calibration estimate of JA temperatures. Original reference for data is McCarroll et al. (2013). For more information about BI, see IBC description above.
POLx	MXD chronology: RCS detrending – see Schneider et al. (2015). Period used for chronology is where replication ≥ 5 series.
YAM	RW chronology: RCS detrending – see Briffa et al. (2013).

ASGrid1	RW and MXD chronologies (varying weighting by grid): STD and RCS detrending. The 2x2 degree spatial resolution of the Cook et al. (2012) gridded reconstructions was reduced to create larger grid averages of 6 by 8 degrees (ca. 700-900 kms between grid centres - see Table 1). As the length of each 2x2 degree grid reconstruction varied, the final period used for each large grid average was where replication was ≥50% of the total number of small grids within each large grid region. Each 2x2 gridded reconstruction was normalised to z-scores over the period 1750-1950 and averaged while variance was stabilised to ensure no heteroscedasticity biases due to changing number of records using a modified equation from Osborn et al. (2007) – Appendix C1.
ASGrid2	See details for ASGrid1.
ASGrid10	See details for ASGrid1.
ASGrid11	See details for ASGrid1.
KYR	RW and MXD based reconstruction: STD detrending - Same version used in Wilson et al. (2007 – Appendix A).
MAN	MXD chronology: RCS detrending – see Schneider et al. (2015). Period used for chronology is where replication ≥ 5 series meaning that there is a gap from 1650-1673.
ASGrid3	See details for ASGrid1.
ASGrid12	See details for ASGrid1.
ALT	MXD chronology: RCS detrending – see Schneider et al. (2015). Period used for chronology is where replication ≥ 5 series.
ASGrid4	See details for ASGrid1.
ASGrid13	See details for ASGrid1.
OZN	RW based reconstruction: RCS detrending – see Davi et al. (2015)
TAY	RW chronology: RCS detrending - Same version used in DWJ06 – original reference Jacoby et al. (2000)
ASGrid5	See details for ASGrid1.
ASGrid14	See details for ASGrid1.
ASGrid6	See details for ASGrid1.
ASGrid15	See details for ASGrid1.
ASGrid7	See details for ASGrid1.
ASGrid16	See details for ASGrid1.
ASGrid8	See details for ASGrid1.
ASGrid17	See details for ASGrid1.
ASGrid9	See details for ASGrid1.

ASGrid18	See details for ASGrid1.
NJAP	RW and MXD based reconstruction: STD detrending – see D'Arrigo et al. (2014)
YAK	RW chronology: RCS detrending - Same version used in DWJ06 – original reference Hughes et al. (1999)

Appendix Table A1: Meta information for each chronology/reconstruction used for N-TREND2015.

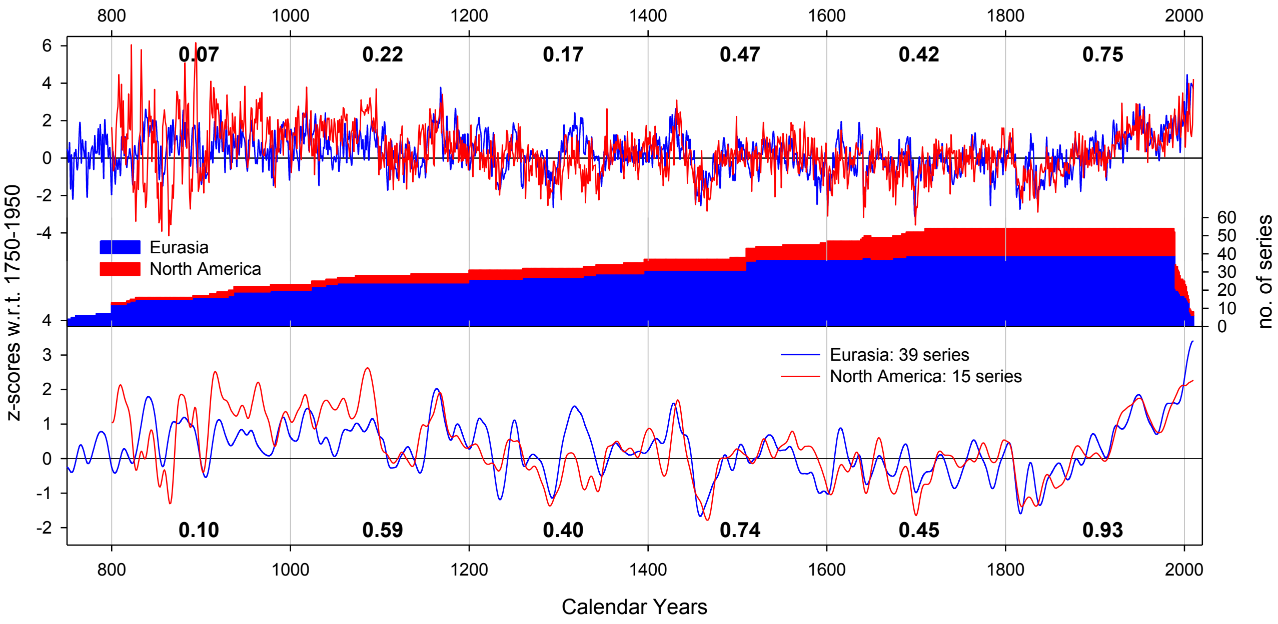
Model	No. of Ens.	Solar	Volcanic	GHG	Land Use	Reference
BCC-CSM-1.1	1	Viera et al. (2011)	Gao et al. (2008)	Schmidt et al. (2012)	-	Wu et al (2013)
CCSM4	1	Viera et al. (2011)	Gao et al. (2008)	Schmidt et al. (2012)	Pongratz et al. (2008)	Landrum et al (2013)
GISS-E2-R 121	1	Steinhilber et al	Crowley and Unterman (2013)	Schmidt et al. (2012)	Pongratz et al. (2008)	Schmidt et al (2014)
GISS-E2-R 124	1	Viera et al. (2011)	Crowley and Unterman (2013)	Schmidt et al. (2012)	Pongratz et al. (2008)	Schmidt et al (2014)
GISS-E2-R 127	1	Viera et al. (2011)	Crowley and Unterman (2013)	Schmidt et al. (2012)	Kaplan et al. (2010)	Schmidt et al (2014)
FGOALS-gl	1	Crowley (2000)	Crowley (2000)	Amman et al. (2007)	-	Guo and Zhou (2013)
HadCM3	1	Steinhilber et al. (2009)	Crowley and Unterman (2013)	Schmidt et al. (2012)	Pongratz et al. (2008)	Schurer et al (2013)
MPI-ESM-P	3	Viera et al. (2011)	Crowley and Unterman (2013)	Schmidt et al. (2012)	Pongratz et al. (2008)	Jungclaus et al (2014)

Appendix Table A2: References for forcing information for each CMIP5 model.

Appendix B – Detailed calibration and validation nesting results and error estimation

			FULL calibration 1880-1988						Smoothed calibration 20 yr spline: 1880-1988		Early Calibration/Late Verification 1880-1934 vs 1935-1988				Late Calibration/Early Verification 1935-1988 vs 1880-1934				Early/Late Calibration/mid verification 1880-1915/1953-1988 vs 1916-1952			
Nest no.	Period	No. series	r2	DW	LinR	RMSE scaled best	RMSE additional	RMSE total	r2 SPL20	RMSE adjusted	Calr2	VerR2	VerRE	VerCE	Calr2	VerR2	VerRE	VerCE	Calr2	VerR2	VerRE	VerCE
BACK																						
1	1710-1988	54	0.41	1.88	-0.03	0.24	0.14	0.38	0.81	0.09	0.38	0.20	0.51	0.04	0.20	0.38	0.55	0.31	0.45	0.21	0.33	0.15
2	1689-1709	52	0.41	1.93	0.02	0.24	0.14	0.38	0.83	0.09	0.39	0.20	0.54	0.09	0.20	0.39	0.54	0.29	0.44	0.26	0.36	0.19
3	1684-1688	51	0.41	1.94	0.03	0.24	0.14	0.38	0.84	0.09	0.39	0.20	0.55	0.10	0.20	0.39	0.54	0.29	0.44	0.27	0.37	0.21
4	1642-1683	50	0.43	1.93	0.03	0.24	0.14	0.38	0.84	0.09	0.41	0.22	0.57	0.14	0.22	0.41	0.56	0.32	0.46	0.28	0.39	0.22
5	1640-1641	49	0.45	1.96	0.02	0.23	0.14	0.38	0.88	0.09	0.42	0.25	0.59	0.19	0.25	0.42	0.57	0.34	0.47	0.30	0.42	0.26
6	1638-1639	48	0.45	1.96	0.01	0.23	0.14	0.38	0.88	0.09	0.42	0.26	0.59	0.19	0.26	0.42	0.58	0.34	0.47	0.31	0.43	0.27
7	1600-1637	47	0.45	1.94	0.03	0.23	0.15	0.38	0.87	0.09	0.43	0.26	0.60	0.20	0.26	0.43	0.57	0.33	0.49	0.29	0.41	0.25
8	1593-1599	46	0.43	1.97	0.05	0.24	0.15	0.38	0.86	0.09	0.40	0.25	0.60	0.20	0.25	0.40	0.55	0.30	0.46	0.28	0.40	0.24
9	1551-1592	45	0.46	1.99	0.05	0.23	0.15	0.38	0.87	0.09	0.43	0.27	0.61	0.22	0.27	0.43	0.57	0.33	0.49	0.29	0.40	0.24
10	1521-1550	44	0.46	2.00	0.04	0.23	0.15	0.38	0.89	0.09	0.43	0.27	0.60	0.21	0.27	0.43	0.57	0.34	0.49	0.29	0.41	0.25
11	1510-1520	43	0.47	2.00	0.03	0.23	0.15	0.38	0.89	0.09	0.44	0.29	0.62	0.24	0.29	0.44	0.59	0.36	0.51	0.30	0.41	0.26
12	1492-1509	38	0.45	1.94	0.05	0.24	0.16	0.40	0.85	0.10	0.41	0.27	0.61	0.22	0.27	0.41	0.57	0.33	0.49	0.28	0.37	0.20
13	1396-1491	37	0.43	1.94	0.05	0.24	0.16	0.41	0.87	0.10	0.40	0.24	0.58	0.17	0.24	0.40	0.55	0.30	0.46	0.27	0.38	0.22
14	1373-1395	35	0.43	1.92	0.06	0.24	0.17	0.41	0.87	0.10	0.40	0.24	0.59	0.18	0.24	0.40	0.54	0.29	0.47	0.24	0.35	0.18
15	1342-1372	34	0.39	1.77	0.05	0.25	0.17	0.42	0.84	0.10	0.43	0.12	0.48	-0.04	0.12	0.43	0.46	0.16	0.44	0.19	0.28	0.09
16	1328-1341	33	0.39	1.76	0.04	0.25	0.17	0.43	0.84	0.10	0.43	0.12	0.47	-0.06	0.12	0.43	0.46	0.16	0.45	0.18	0.27	0.07
17	1260-1327	32	0.38	1.75	0.04	0.26	0.18	0.43	0.85	0.10	0.42	0.11	0.47	-0.05	0.11	0.42	0.45	0.15	0.43	0.19	0.28	0.09
18	1200-1259	31	0.40	1.77	0.03	0.25	0.18	0.43	0.86	0.10	0.43	0.12	0.47	-0.05	0.12	0.43	0.48	0.19	0.44	0.21	0.31	0.13
19	1135-1199	29	0.37	1.77	0.05	0.26	0.19	0.44	0.85	0.11	0.40	0.10	0.47	-0.05	0.10	0.40	0.44	0.12	0.41	0.20	0.32	0.13
20	1073-1134	28	0.33	1.69	0.03	0.26	0.19	0.45	0.80	0.11	0.38	0.06	0.39	-0.20	0.06	0.38	0.34	-0.02	0.37	0.15	0.26	0.06
21	1053-1072	27	0.29	1.64	0.08	0.27	0.19	0.47	0.80	0.12	0.34	0.04	0.39	-0.21	0.04	0.34	0.28	-0.12	0.34	0.12	0.23	0.03
22	1040-1052	26	0.30	1.64	0.08	0.27	0.20	0.47	0.80	0.12	0.33	0.04	0.40	-0.19	0.04	0.33	0.28	-0.11	0.34	0.12	0.22	0.01
23	1024-1039	25	0.30	1.67	0.09	0.27	0.20	0.47	0.82	0.12	0.34	0.05	0.41	-0.16	0.05	0.34	0.31	-0.08	0.35	0.13	0.24	0.04
24	978-1023	23	0.30	1.69	0.09	0.28	0.21	0.48	0.82	0.12	0.33	0.05	0.42	-0.14	0.05	0.33	0.31	-0.07	0.35	0.12	0.24	0.04
25	937-977	22	0.30	1.68	0.09	0.28	0.21	0.49	0.82	0.12	0.31	0.05	0.43	-0.12	0.05	0.31	0.31	-0.07	0.34	0.12	0.23	0.02
26	931-936	20	0.35	1.70	0.08	0.26	0.22	0.48	0.85	0.12	0.38	0.08	0.46	-0.08	0.08	0.38	0.38	0.04	0.38	0.17	0.32	0.13
27	918-930	19	0.34	1.70	0.09	0.26	0.23	0.49	0.86	0.12	0.37	0.08	0.45	-0.09	0.08	0.37	0.37	0.02	0.37	0.16	0.30	0.12
28	910-917	18	0.29	1.72	0.14	0.28	0.24	0.51	0.84	0.12	0.32	0.06	0.40	-0.18	0.06	0.32	0.29	-0.11	0.32	0.14	0.26	0.06
29	891-909	17	0.24	1.69	0.15	0.30	0.24	0.54	0.76	0.14	0.24	0.06	0.38	-0.23	0.06	0.24	0.26	-0.16	0.27	0.08	0.22	0.02
30	827-890	16	0.24	1.68	0.15	0.30	0.25	0.55	0.79	0.14	0.26	0.05	0.36	-0.27	0.05	0.26	0.24	-0.19	0.27	0.08	0.21	0.00
31	821-826	15	0.26	1.67	0.15	0.30	0.26	0.55	0.78	0.14	0.27	0.06	0.38	-0.23	0.06	0.27	0.27	-0.14	0.29	0.08	0.23	0.03
32	817-820	14	0.23	1.65	0.16	0.30	0.27	0.57	0.76	0.15	0.26	0.04	0.35	-0.30	0.04	0.26	0.23	-0.20	0.27	0.06	0.20	-0.02
33	800-1816	13	0.23	1.63	0.16	0.31	0.28	0.58	0.70	0.16	0.22	0.05	0.37	-0.25	0.05	0.22	0.24	-0.18	0.25	0.06	0.22	0.01
34	783-799	7	0.32	1.68	0.14	0.31	0.38	0.69	0.71	0.18	0.35	0.07	0.43	-0.13	0.07	0.35	0.33	-0.04	0.41	0.05	0.06	-0.19
35	760-782	6	0.29	1.69	0.17	0.31	0.41	0.72	0.71	0.19	0.32	0.06	0.40	-0.19	0.06	0.32	0.30	-0.09	0.37	0.03	0.10	-0.14
36	755-759	5	0.21	1.73	0.23	0.35	0.45	0.80	0.65	0.22	0.24	0.03	0.31	-0.37	0.03	0.24	0.18	-0.28	0.28	0.00	0.02	-0.24
37	750-754	4	0.21	1.76	0.19	0.38	0.50	0.88	0.67	0.24	0.21	0.02	0.34	-0.32	0.02	0.21	0.18	-0.27	0.27	0.01	0.09	-0.15
FORWARD																						
1	1989	52	0.38	1.78	-0.01	0.25	0.14	0.39	0.80	0.10	0.38	0.14	0.46	-0.07	0.14	0.38	0.50	0.23	0.44	0.17	0.26	0.06
2	1990	34	0.35	1.68	0.07	0.27	0.17	0.44	0.73	0.11	0.35	0.12	0.50	0.00	0.12	0.35	0.44	0.13	0.42	0.14	0.17	-0.05
3	1991-1992	33	0.34	1.68	0.07	0.27	0.17	0.44	0.73	0.12	0.33	0.11	0.51	0.02	0.11	0.33	0.44	0.12	0.40	0.14	0.17	-0.05
4	1993	31	0.35	1.64	0.05	0.27	0.18	0.45	0.71	0.12	0.33	0.11	0.51	0.03	0.11	0.33	0.44	0.14	0.41	0.13	0.19	-0.03
5	1994	30	0.34	1.65	0.05	0.27	0.18	0.45	0.72	0.12	0.32	0.11	0.51	0.02	0.11	0.32	0.44	0.12	0.38	0.15	0.26	0.07
6	1995	28	0.34	1.66	0.02	0.28	0.19	0.47	0.73	0.12	0.33	0.10	0.50	0.00	0.10	0.33	0.45	0.14	0.40	0.12	0.24	0.03
7	1996-1998	26	0.33	1.73	0.04	0.28	0.20	0.48	0.72	0.13	0.30	0.10	0.49	0.00	0.10	0.30	0.42	0.09	0.36	0.13	0.26	0.06
8	1999-2000	25	0.32	1.74	0.09	0.28	0.20	0.48	0.72	0.13	0.32	0.08	0.46	-0.07	0.08	0.32	0.37	0.02	0.33	0.17	0.31	0.13
9	2001	23	0.32	1.74	0.09	0.28	0.21	0.49	0.72	0.13	0.32	0.09	0.48	-0.04	0.09	0.32	0.38	0.04	0.34	0.17	0.31	0.13
10	2002	22	0.34	1.74	0.10	0.28	0.21	0.49	0.74	0.13	0.36	0.08	0.46	-0.07	0.08	0.36	0.38	0.04	0.37	0.17	0.28	0.09
11	2003	19	0.34	1.70	0.11	0.29	0.23	0.52	0.71	0.14	0.38	0.07	0.44	-0.12	0.07	0.38	0.36	0.01	0.37	0.14	0.30	0.12
12	2004	17	0.32	1.72	0.12	0.29	0.24	0.53	0.72	0.14	0.36	0.06	0.42	-0.15	0.06	0.36	0.33	-0.05	0.35	0.12	0.29	0.09
13	2005	15	0.25	1.69	0.13	0.31	0.26	0.57	0.73	0.15	0.29	0.01	0.36	-0.27	0.01	0.29	0.17	-0.29	0.28	0.06	0.22	0.01
14	2006	10	0.23	1.58	0.14	0.31	0.32	0.63	0.76	0.16	0.27	0.02	0.34	-0.31	0.02	0.27	0.18	-0.27	0.27	0.05	0.18	-0.04
15	2007	9	0.20	1.55	0.17	0.32	0.33	0.65	0.80	0.16	0.26	0.01	0.28	-0.42	0.01	0.26	0.11	-0.39	0.24	0.03	0.14	-0.09
16	2008-2010	8	0.20	1.53	0.17	0.32	0.35	0.67	0.79	0.17	0.25	0.02	0.31	-0.38	0.02	0.25	0.15	-0.33	0.24	0.04	0.15	-0.08
17	2011	3	0.13	1.36	0.24	0.33	0.58	0.91	0.23	0.42	0.17	0.00	0.25	-0.49	0.00	0.17	-0.03	-0.60	0.21	0.13	-0.15	-0.46

Appendix Table B1: Calibration and validation results for each nested model. R^2, square of the multiple correlation coefficient; DW, Durbin and Watson statistic for residual autocorrelation; Lin R, correlation of linear trend of residuals; RMSE, root-mean-square error; RE, reduction of error; CE, coefficient of efficienc. Red values denote non-significance for residual analysis and validation metrics.



Appendix Figure C3: Comparison of North American and Eurasian composite mean series. Data are expressed as Z-score relative to the 1750-1950 period. Upper (lower) panel are unfiltered (filtered – 20-year spline) versions. Numerical values in upper and lower panels show correlations between the EU and NA unfiltered and filtered series for 200-year blocks.

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