Online Material 1

Comparison between the JJA temperature gridded dataset based on proxy, documentary, and instrumental data of Luterbacher et al. (2004), the JJA temperature based on instrumental data of Brunetti et al. (2006), the reconstructed series of AS temperature of central and southern Italy (Leonelli et al., this work), and a mixed series of AS and JAS temperature comprising the three reconstructed series in the study region: Trouet (2014), Leonelli et al. (this work) and Klesse et al. (2015); see Figure OM1).

The JJA series of Luterbacher et al. (2004) is obtained from the series of the grid points containing the Italian MXD sites of this work and following the same approach as for the regionalization of the temperature series used in this study; the series of Brunetti et al. (2006) is derived from the series at the study sites (see Methods). The reconstructed series are centered over the respective study regions: North Eastern Mediterranean-Balkan region (Trouet, 2014), central and southern Italy (Leonelli et al., this work), and Greece (Klesse et al., 2015).

The series are here compared as z-scores calculated over the common period 1774-1980, back to 1763, i.e. the first year with at least one meteorological station providing instrumental data based in Italy (the Milano station; Luterbacher et al., 2004). Before 1763, no instrumental data is available for Italy.

References as in the paper.

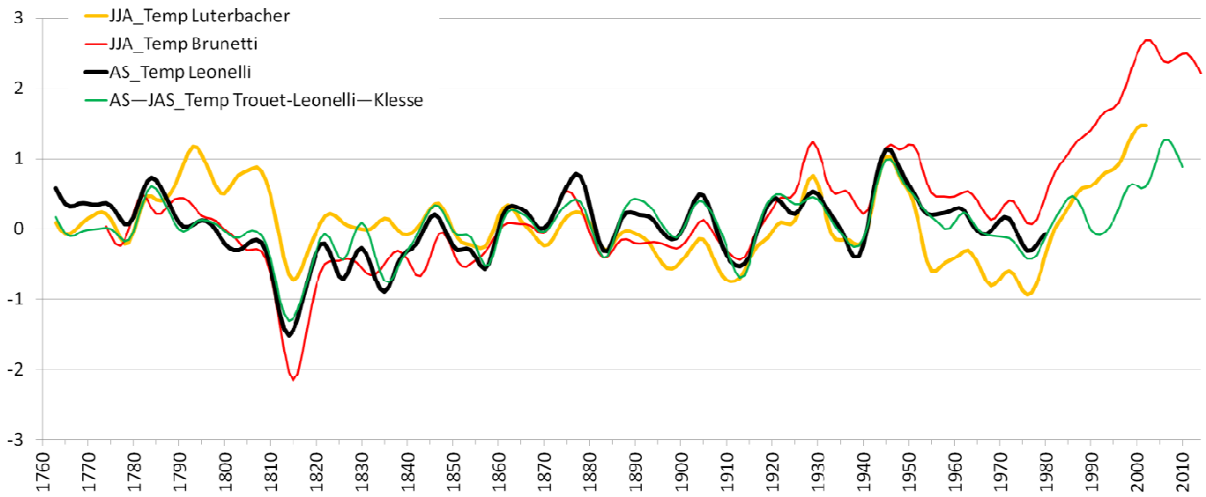

Figure OM1: Comparison of temperature series from the study region:
- JJA temperature based on proxy, documentary, and instrumental data (yellow line; mean conditions for the gridpoints containing the MXD sites of this work, data from Luterbacher et al., 2004),
- JJA temperature based only on instrumental data (red line; mean conditions for the MXD sites of this work, data from an improved version of Brunetti et al., 2006).
- AS temperature, reconstructed series with scaling approach (black line; Leonelli et al., this work),
- AS—JAS, a mixed series of summer temperature in the study region (green line; Trouet, 2012; Leonelli et al., this work; Klesse et al., 2015).
The z-scored series above described, are here low-pass filtered with a 20 yr Gaussian filter.

We also performed a more detailed comparison between the summer temperature series available in the study region (Table OM1): Luterbacher et al. (2004), Brunetti et al. (2006), Trouet (2014), Leonelli et al. (this study), Klesse et al. (2015). The correlation coefficient was calculated over the common period 1774-1980 (i.e., over the common period covered with data from all series), for all combinations of summer (JJA; JAS) and late-summer (AS) months considered.

Table OM1: Correlation coefficients calculated for the different variables in the study region. Z-scores were calculated on the common period 1774-1980 and the comparisons between same variables from the different datasets are marked in bold characters. In the first column the comparisons between JJA temperature of Luterbacher et al. (2004) vs. the JJA, JAS and AS temperature of Brunetti et al. (2006) are reported, second, third and fourth columns contain the comparisons of AS temperature (Trouet, 2014, and Leonelli et al., this work) and JAS temperature (Klesse et al., 2015). vs. the JJA, JAS and AS temperature of Brunetti et al. (2006). Please note that the series form Luterbacher et al. (2004) and Brunetti et al. (2006) are centered over the Italian MXD sites, whereas the reconstructed series of Trouet (2014) and Klesse et al. (2015) are centered over the respective study regions, as above specified.

	JJA Temp - LUTERBACHER		**AS Temp** - TROUET_MXD		**AS Temp** - LEONELLI_MXD_SCALING		**JAS Temp** - KLESSE_MXD	
	z-scores	20 yr gaussian	z-scores	20 yr gaussian	z-scores	20 yr gaussian	z-scores	20 yr gaussian
JJA Temp - LUTERBACHER	-	-	0.46	0.64	0.42	0.38	0.23	0.28
JJA Temp - BRUNETTI	**0.70**	0.32	0.44	0.58	0.56	0.83	0.29	0.70
JAS Temp - BRUNETTI	0.50	0.29	0.54	0.62	0.64	0.82	**0.33**	0.70
AS Temp - BRUNETTI	0.39	0.35	**0.56**	0.62	**0.66**	0.81	0.30	0.65