## Supplementary Tables

<table>
<thead>
<tr>
<th>Name</th>
<th>Proxy</th>
<th>Season of strongest correlation</th>
<th>Series length</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCTIC$^1$</td>
<td>Composite of various tree ring series. Multi site.</td>
<td>June-August</td>
<td>2007-1085</td>
</tr>
<tr>
<td>ALPINE$^2$</td>
<td>Composite of various sedimentary and tree ring series. Multi site.</td>
<td>June-August</td>
<td>1996-1053</td>
</tr>
<tr>
<td>PYRENEES$^3$</td>
<td>Composite of various tree ring series. Multi site.</td>
<td>May-Sept</td>
<td>2005-1260</td>
</tr>
</tbody>
</table>

Supplementary Table 1: Description of proxy composite series used and results of a Principal Components Analysis of the ARCTIC, ALPINE, CENTRAL and PYRENEES series.
2. Supplementary figures

**Figure S1. Correlations patterns between CCSM4 output and climate fields.** Correlations patterns, derived from the output of the past1000 and historical simulations with CCSM4, between time series of the European summer (JJA) meridional temperature gradient (10°W, 30°E: 35°N,70°N) and climatic fields, over the same season: A) 2m air temperature, B) precipitation, C) synoptic activity defined as the high-pass (2-6 day) filtered sea-level-pressure variance, D) sea-level-pressure, E) downwelling solar radiation at the surface, F) total radiation at the top of the atmosphere (long wave and short wave combined, positive downwards). All time series are 21-year low-pass filtered. 95% significance is close to ±0.20 (see Online Methods)
Figure S2. Principal Component Analysis of European temperature deviations from the continental mean. Leading empirical orthogonal function of the near-surface summer (JJA) temperature deviations from the European spatial mean in the r1i1p1 simulations past1000 and historical simulations (concatenated), with the models MPI-ESM-P (a) and CCSM4 (b) from the CMIP5 suite. The temperature series have been smoothed with a 21-year low-pass filter. Left panel: MPI-ESM-P, explaining 33% of the variance; right panel, CCSM4, explaining 42% of the variance. Note the different scaling in the panels.
Figure S3. Links between the observed/reconstructed European summer (JJA) temperature gradient and atmospheric circulation. Panels on the left, interannual correlation patterns with summer (JJA) European meridional temperature gradient derived from the HadCRUT4 gridded temperatures. Panels on the right, with the meridional proxy gradient derived from the summer (JJA) temperature proxies (see main text). Upper row: correlation to the gridded precipitation AD 1900-1996\(^5\) middle row, correlation to the gridded sea-level-pressure\(^6\) AD 1900-1996. Bottom row; correlations with synoptic activity, defined as the high-pass filtered (2-6 days) standard deviation of the daily sea-level-pressure from the NCEP/NCAR reanalysis\(^7\) AD 1948-1996. Scale bar indicates correlation (r=). 95% significance level is close to ±0.25 for the left panels and close to ±0.20 for the right panels (See Online Methods).
Figure S4. Link between the Atlantic Overturning Circulation and the meridional temperature gradient in the MPI-ESM simulation  

Correlation pattern between the index of the maximum of the meridional stream function in the North Atlantic ocean (poleward of 20N) in the MPI-ESM simulation (annual mean) and the June-August near surface air temperature in that simulation in the period 850-2005. 95% significance is close to ±0.20 (see SI). The decadal-scale correlation between the AMOC index and the meridional temperature gradient is r=-0.27 (p=0.01).
**Figure S5 Proxy Regions.** The broad proxy regions are indicated. Full details are available from the literature for Arctic¹, Alpine², Pyrenees³, Central⁴.

**References**