Supplementary information

1. *Growth Index*

In order to remove age-related effects on our limited dataset, we have used the following procedure to obtain average growth indices for the 15 trees and the 18 beams sampled:

- For each tree and beam, second order polynomial regressions were calculated;
- Individual growth records were corrected from these polynomial fits;
- The mean value of the detrended records provides our growth index time series (hereafter called GI).

The ring widths time series are represented in Figure A. On individual trees, GI varies between -112.9 and +151.1 x 10^{-2}mm, with, by construction, a mean value of 0. The mean GI (averaged over all individual samples) is affected by the introduction of different samples. As a result, this average GI cannot be as pertinent as signals obtained from RCS methods over large sets of trees (Esper et al., 2003; Büntgen et al, 2006; Guiot et al., 2005). Even after correction for growth heterogeneities and detrending, GI shows no clear relationships with local climate parameters (R^2 = 0.08, n=120, p=0.001) with T_{max} AMJJAS for instance; Etien et al., in press) and is not used in our reconstruction.

2. $\delta^{13}C$ data: inter-tree deviation, auto-correlation

Inter-tree variability

Where the records of the different sites overlap and enough matter is available, their respective tree-rings were not pooled in order to test the signal coherency (Figure 2a of the paper). There is an overlap of 24 years (1698 to 1721) between the $\delta^{13}C$ data obtained for the combined set “Clocher” and “Salle de Bal” with the site “Petites Ecuries” and an overlap of 22 years (1828 to 1849) between the site “Théâtre” and the period covered by living trees. The mean value of $\delta^{13}C$ for the 24 years overlap is -24.35‰ for samples from “Salle des Bals” and “Clocher” and -23.70‰ for samples from “Petites Ecuries”. For the 22 years of overlap, the mean value of $\delta^{13}C$ is -23.85‰ for beams from “Théâtre” and -23.55‰ for living

trees. The observed shifts (0.65‰ and 0.3‰) between the different parts of the record are more than twice the value of analytical precision and are considered as significant.

$\delta^{13}C$ variability between individuals growing under similar conditions seems to be characteristic of C3 plants in general and the variability of the results is not improved by any treatment (using whole wood, holocellulose or α-cellulose) (Van de Water et al., 2002). Several studies based on individual trees, as opposed to pooled samples, report age related trends in carbon isotopic ratios (e.g. McCarroll and Pawelleck, 2001; Raffalli-Delerce et al, 2004; Masson-Delmotte et al, 2005). Tree-age effect consists in a rise in $\delta^{13}C$ followed by a decline and has been attributed to different factors such as changes in access to light, CO_2 isotopic composition gradients, or changes in tree hydraulic conductivity along tree growth (see for instance Schleser and Jayasekera, 1985; Cernusak et al., 2001; McDowell et al., 2002; Schäfer et al., 2000; Monserud and Marshall, 2001).

A juvenile effect, may explain the shape of the $\delta^{13}C$ record in "Clocher and Salle de Bal" (blue line in figure 2a of the paper) and in "Theâtre" samples (pink line of fig. 2a). Note that the tree-ring width measured on the samples of these sites exhibit typical tree-age effects (Figure A). At the contrary, no obvious trend can be identified on the $\delta^{13}C$ curve of "Petites Ecuries" (orange line in figure 2a). For this site, only the 50 last years of the beams were analysed. From the observation of figure A, these rings have obviously grown while the trees were mature (no observable juvenile effect). We are well aware that juvenile effects appear more clearly on individuals than on pooled sample. Anyway, the amount of cellulose necessary to conduct replicate $\delta^{13}C$ and $\delta^{18}O$ analysis, preclude individual sample treatment.

Despite the inconsistencies evidenced in the overlap periods, we have built a $\delta^{13}C$ series by averaging the signals in the overlapping windows. The resulting $\delta^{13}C$ record is presented in figure 3a of the paper. The $\delta^{13}C$ signal is slightly auto-correlated (R^2=0.27 with 1 year lag persistent up to a 13 years lag).

The very likely juvenile effect associated to the autocorrelation of the signal dissuaded us from using $\delta^{13}C$ as a proxy for climate reconstruction.

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Figure captions

Figure A. From bottom to top, time series of:

- Total number of pooled beam and tree samples per year.
- Mean Growth Index of latewood tree rings (x10^{-2} mm).