

Supplementary Information # 2

Synthetic Red Noise Experiments

We performed the experiments described by MM04 , producing various realizations of $M=70$ statistically independent red noise series of length $N=581$ 'years', using an $N(0,1)$ Gaussian innovation forcing and the lag one autocorrelation coefficients of each of the actual $M=70$ North American ITRDB data for the interval 1902-1980.

PCA was calculated based on the un-normalized synthetic data using both a 502-581 zero reference (corresponding to the "1902-1980" centering of MBH98) and a 1-581 zero reference (corresponding to the 1400-1980 centering of MM04). We performed more than a dozen realizations of this process. The eigenvalue spectra for a typical realization are shown for both MBH98 and MM04 centering conventions in 'Supplementary Information #1'.

In no case were we able to identify a situation where the 502-581 centering generated a spurious PC pattern that did not exist in the actual data. We did however find cases where such a pattern appeared slightly farther down in the eigenvalue spectrum or as a linear combination of a few other highly ranked PCs. We provide such an example (Figure 1). In this case, the PC#1 series using the two conventions (502-581 vs. 1-581 centered) are, as in the example shown by MM04, completely uncorrelated (annual correlation $r=-0.06$). However, PC#4 from the 1-581 centered analysis carries much of the signature of the 502-581 PC#1 (annual correlation $r=0.65$), with a similar 'hockey stick' low-frequency shape. In fact, the 502-581 centered PC#1 is almost completely described as a linear combination of the 1-581 centered PC #4 and PC#2 (the annual correlation with PC#2 is $r=-0.45$).

We stress, however, that the synthetic red noise example is not an appropriate model for the actual data. Many of the actual 70 tree-ring chronologies in the ITRDB dataset have 20th century trends that are highly significant relative to the null hypothesis of red noise, and there is large-scale structure in the data that belies the null hypothesis of $M=70$ statistically independent red noise time series. Under such circumstances, the low-frequency patterns of the individual PCs are far more robust with respect to the centering of the data. For example, the PC#1 pattern of the actual North American ITRDB data based on the MBH98 centering convention appears as the nearly identical pattern in the PCA analysis based on the MM04 centering convention, albeit slightly farther down in the eigenvalue spectrum (see Supplementary Information #1).

FIGURE 1. Comparison of PC#1 from year 1-581 centered analysis (blue) and PC #4 from the year 502-581 centered analysis (red). Both PCs are standardized to have the same mean and standard deviation, for purposes of comparison. A 100 year smooth of both series is also shown to highlight the low-frequency variations.

