SampleOutputPrecDend.pdf

This Supplemental Materials document compares output of seascorr (Meko et al., 2011) with output of PRECON 5.1 (Fritts, 1999) and DENDROCLIM2002 (Biondi and Waikul, 2004) run on the Tunisia example described by Meko et al. (2011). Input data are a standard tree-ring index from Tunisia and gridded monthly precipitation P and temperature T data. Input files are:

1. sad_std.txt, the tree-ring index
2. 7.5-9.5E_34.5-36.5N_ppt.txt, the monthly precipitation
3. 7.5-9.5E_34.5-36.5N_temp.txt, the monthly temperature

PRECON 5.1 and DENDROCLIM2002, like seascorr, compute and graph monthly correlations of P with tree-ring index, though they estimate significance of correlation by different procedures. PRECON 5.1 and DENDROCLIM2002 also identify months of significant P and T influence by so-called "response function analysis" (RFA), which consists of the following steps: 1) Principal components analysis (PCA) on the time series matrix of monthly climate data, 2) regression of tree-ring index on the scores of some reduced set of principal components (PCs), 3) re-expression of the regression coefficients on the PC scores as regression coefficients on the original monthly climate variables, and 4) re-sampling and repetition of steps 1-3 to get bootstrapped confidence intervals for the re-expressed coefficients.

The Seascorr results for the Tunisia data are shown in Figure 1. This figure is repeated here for ease of comparison only. The reader is referred to Meko et al. (2011) and SampleOutputSeascorr.pdf for detailed discussion of seascorr results. The remainder of this document describes comparative output from PRECON 5.1 and DENDROCLIM2002 by both correlation and RFA.

Figures 2 and 3 show correlation results from PRECON 5.1 and DENDROCLIM2002, and 4 and 5 show corresponding response-function results. Using correlations, PRECON 5.1 DENDROCLIM2002, and Seascorr identify the same six months of significant monthly P influence: these are the leftmost significant bars in Figure 1 (top). Using RFA, DENDROCLIM2002 and PRECON identify slightly different combinations of 4-6 months, though except for June, these months are in the same eight-month time window that contains all the significant simple correlations (Table 1).[1]

No two of the methods identify exactly the same months with significant P influence on growth. Possible sources of difference are many, and it is impossible to say one assessment is correct and the others wrong. Seascorr does not orthogonalize and reduce the climate data, unlike the other two methods. PRECON includes prior year's tree-ring index as a variable in the time-series matrix of monthly climate data to be orthogonalized, while DENDRO2002 does not. The algorithms for retention of PCs, and for assessing significance from bootstrapped coefficients may differ in PRECON and DENDRO2002 (see Biondi and Waikul (2004)). Finally, even with identical procedures, bootstrapped or Monte-Carlo-derived confidence intervals can differ from run-to-run due to random sampling variability. The various methods are consistent, however, in identifying broadly a cool-season precipitation dependence, and this is further supported by the seascorr results for seasonally-summed P (Figure 1).

PRECON gives the same results as DENDROCLIM2002 for the monthly T signal: September with a positive response, and no other months significant. Seascorr T results are shown in Figure 1 (bottom). Seascorr identifies May as the only month of significant response, with a negative relationship. Note, however, that seascorr does indicate a high positive, though not significant, T partial correlation for September.

The moving-window results from DENDROCLIM2002 broadly support temporal stability of the relationship between precipitation and tree-ring index for October and for the individual months of March-May

[1] Comparison restricted to $\alpha = 0.05$ because PRECON and DENDRO2002 flag that level only.

(Figures 6 and 7). The results for single-month October precipitation are consistent with those of the difference-of-correlation test in `Seascorr`, as reported in Figure 6 of (Meko et al., 2011). `Seascorr` indicated significant tree-ring signal for October precipitation, and that we should not reject a null hypothesis that the sample correlations of precipitation for the 1903-1952 and 1953-2002 are from the same population. `DENDROCLIM2002` also indicates temporal stability of precipitation signal in months March, April and May `Seascorr` is consistent with this result in flagging March-May as the strongest 3-month precipitation season and in showing no significant difference in the correlation of March-May total precipitation with tree-ring index in the first and second halves of the 1903-2002 analysis period. (Meko et al., 2011).

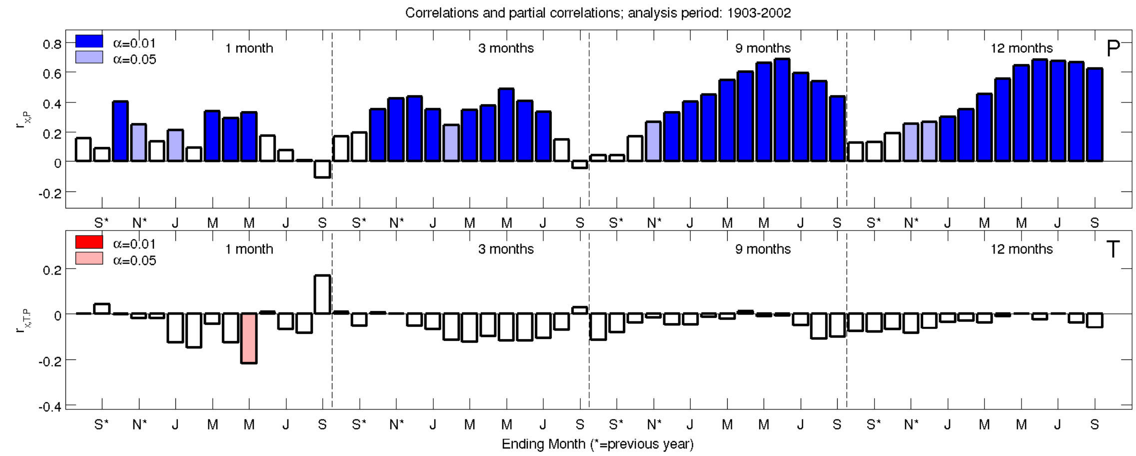

Figure 1: Correlations and partial correlations of tree-ring series with seasonalized climate variables. (Top) Simple correlations with the primary climate variable, P. (Bottom) Partial correlations of tree-ring index with secondary climate variable, T. Significance at $\alpha = 0.05$ and $\alpha = 0.01$ color-coded. Notation $r_{x,P}$ means correlation of x (tree-ring series) with P (precipitation); $r_{x,T.P}$ means partial correlation of x with T (temperature), controlling for influence of P.

.

Table 1: Months with significant monthly precipitation response as identified by different computer programs. `PRECON` and `DENDRO2002` results are from response functions.

	Program[b]		
Month[a]	SEAS	PREC	DEND
Oct*	X	X	X
Nov*	X		
Dec*		X	
Jan	X	X	X
Mar	X		X
Apr	X	X	
May	X	X	X
Jun		X	

[a] Months with significant ($\alpha = 0.05$) response (* denotes previous year)

[b] SEAS=`seascorr`; PREC=`PRECON`; DEND=`DENDRO2002`

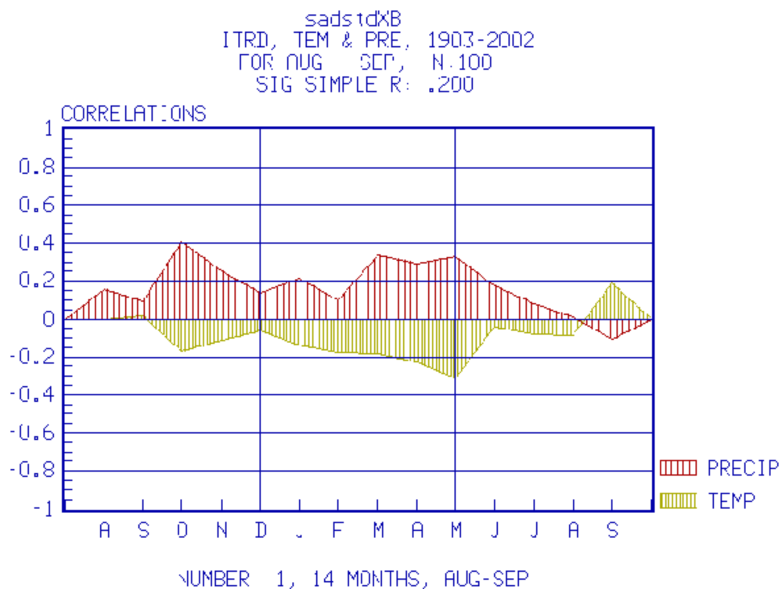

Figure 2: Correlation output from PRECON 5.1. Correlations greater than 0.20 are considered significant at 95% level. For precipitation, same 6 months are flagged as by `seascorr` Meko et al. (2011).Temperature correlations cannot be compared with `seascorr` partial correlations.

References

Biondi, F., Waikul, K., 2004. Dendroclim2002: A C++ program for statistical calibration of climate signals in tree-ring chronologies. Computers & Geosciences 30, 303–311.

Fritts, H. C., 1999. Precon version 5.1: A statistical model for analyzing the tree-ring response to variations in climate, laboratory of Tree-Ring Research, University of Arizona, Tucson, AZ.

Meko, D. M., Touchan, R., Anchukaitis, K. A., 2011. Seascorr: a MATLAB program for identifying the seasonal climate signal in an annual tree-ring time series. Computers & Geosciences submitted (xxx), xxx–xxx.

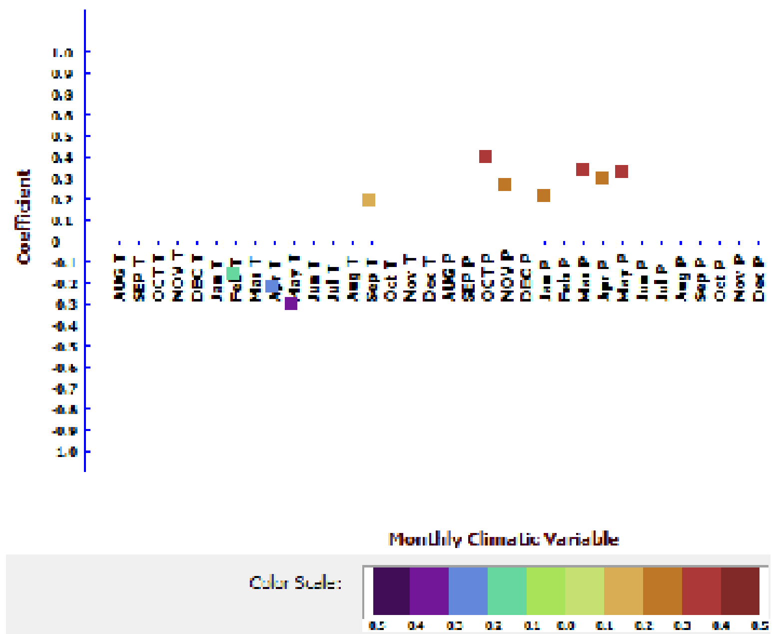

Figure 3: Correlation output from DENDROCLIM2002. Correlations significant at 95% level are flagged by colored squares. For precipitation, same 6 months are flagged as by `seascorr` Meko et al. (2011). Temperatue correlations cannot be compared with `seascorr` partial correlations.

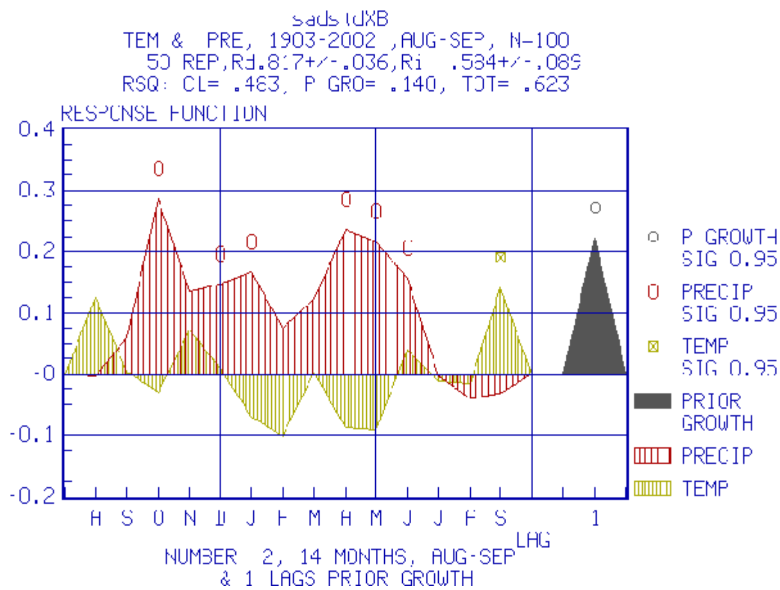

Figure 4: Response function output from PRECON 5.1.

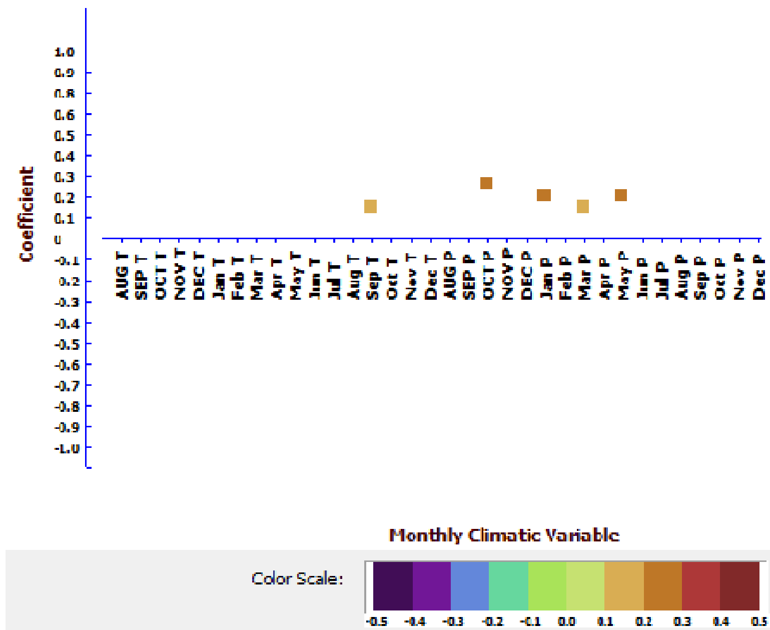

Figure 5: Response function output from DENDROCLIM2002. Significance at 95% level flagged by colored squares.

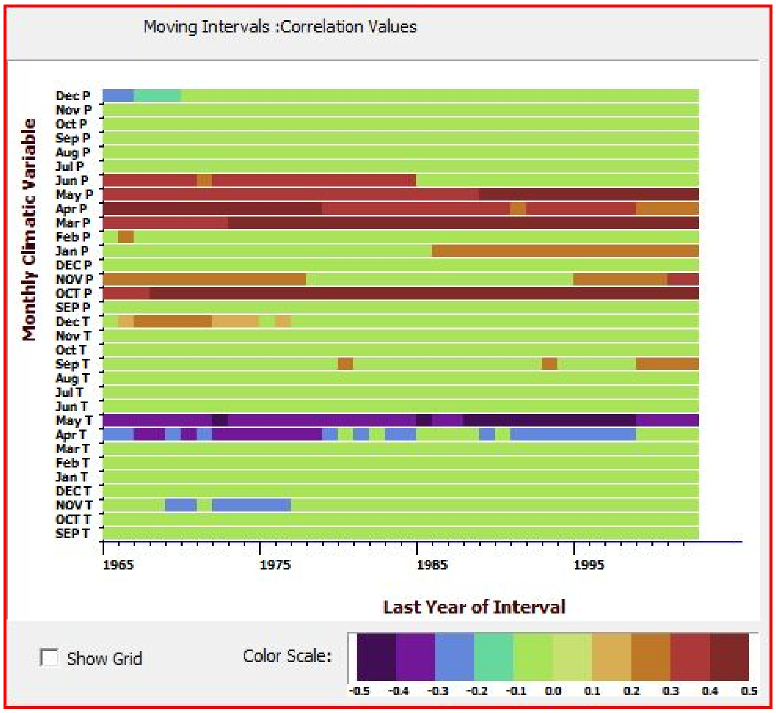

Figure 6: Moving-interval correlation from DENDROCLIM2002. Program run with 63-yr moving window. Significance at 95% level flagged by colored squares.

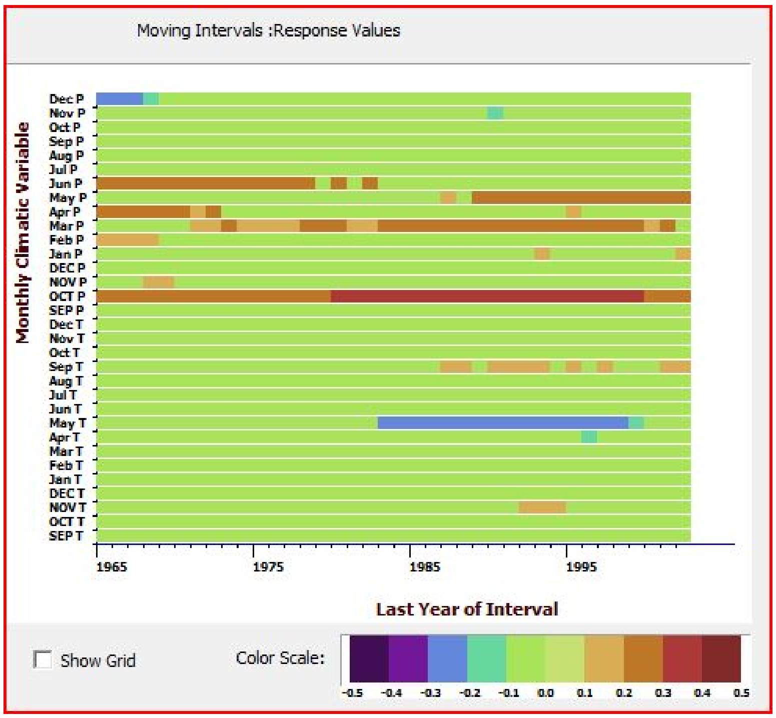

Figure 7: Moving-interval response function from DENDROCLIM2002. Program run with 63-yr moving window. Significance at 95% level flagged by colored squares.