Testing tree-ring climate proxies and detrending methods in southwestern Iberian *Pinus pinea* L. ecosystems

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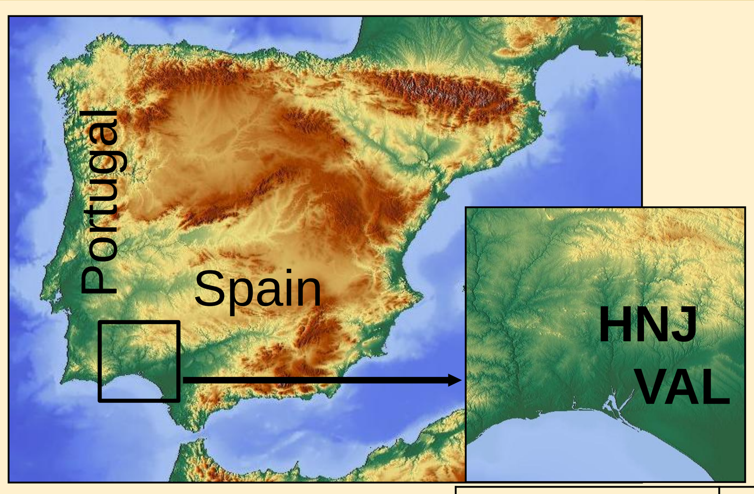
Introduction & objective

The adaptive response of forests to climate change can be accessed through the study of the climatic signal contained in master chronologies, *i.e.* chronologies averaged from detrended series of tree-ring parameters. Primary data and detrending methods influence the information content of a master chronology. Removing or conserving the climate change-induced low-frequency growth variability depend on the applied detrending method. We tested detrending criteria on tree-ring widths and intra-annual growth data.

Materials & methods



	VAL	HNJ
Altitude (m a.s.l.)	260	70
No. of trees (cores)	15 (30)	17 (34)
Mean TR width (mm)	1.74	1.91
Standard deviation (mm)	1.27	1.48
1st-order autocorrelation	0.78	0.68
Time span	1881-2011	1866-2012

Primary data: tree-ring (TR), earlywood (EW) and latewood (LW) widths

Detrending criteria:

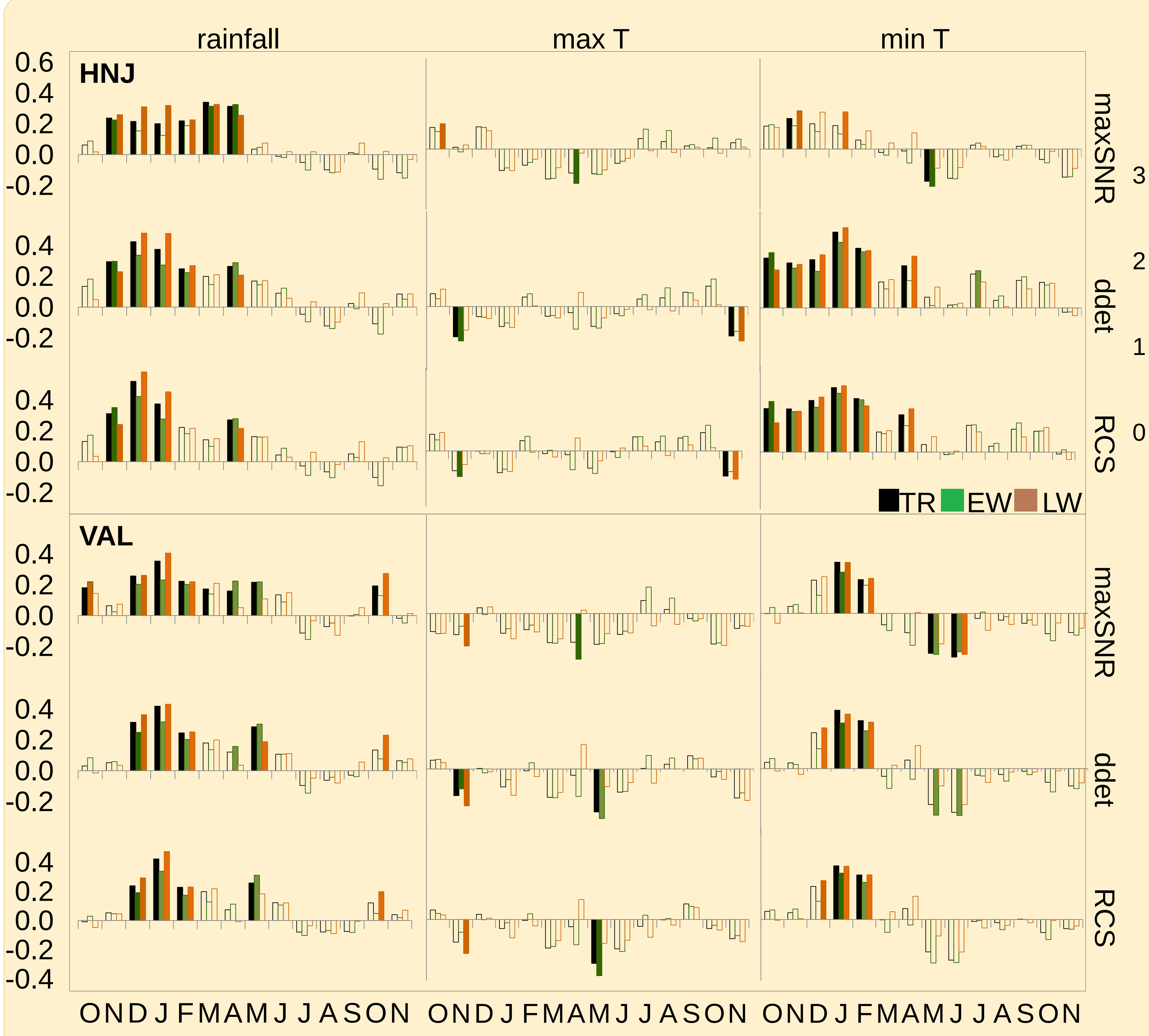
(1) double-detrending (ddet): tree-ring indices were computed from a negative exponential curve and then detrended a second time using a smoothing spline with a rigidity equal to 67% of series length [(1)]

(2) Regional Curve Standardization (RCS) [(2)];

(3) smoothing spline with a rigidity that maximized the signal-to-noise ratio (maxSNR) [(3)].

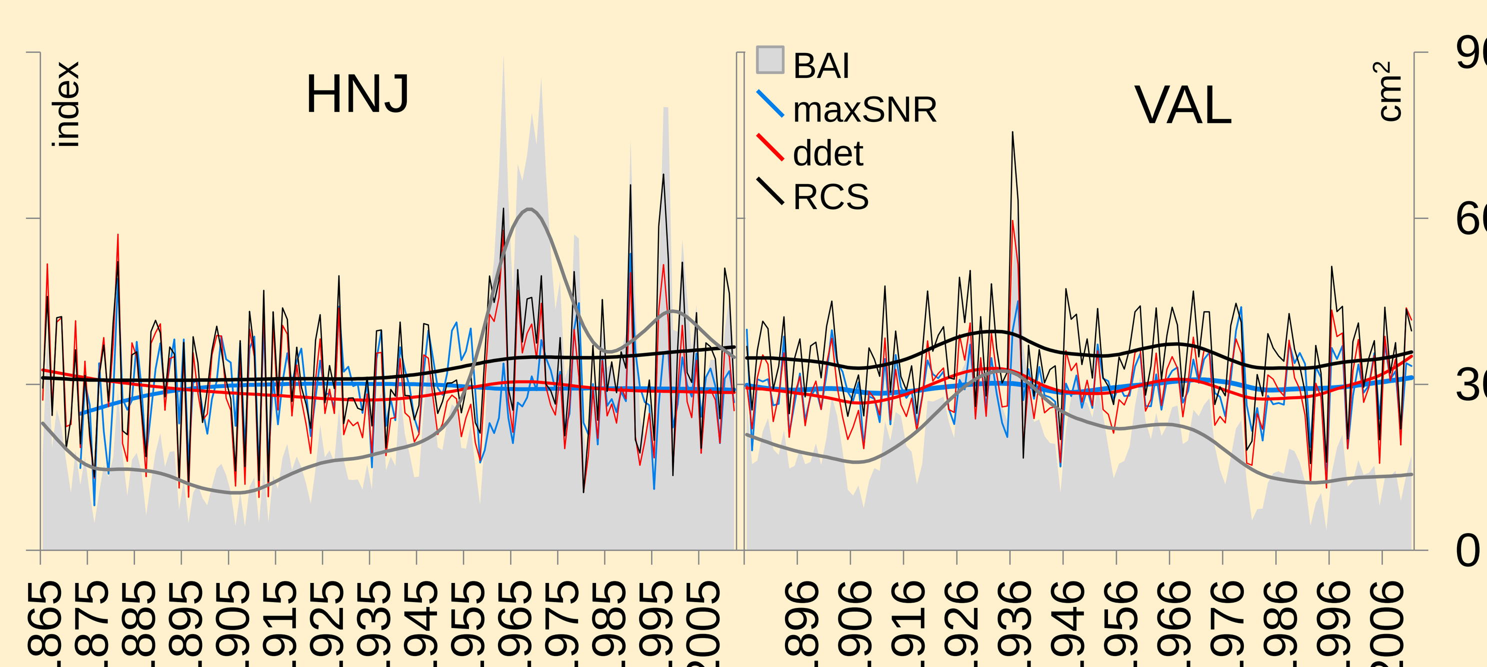
The high-frequency growth response to climate was studied through bootstrapped correlations between prewhitened master chronologies and meteorological covariates. Residual low-frequency trends in the TR master chronologies were compared with BAI (basal area increment) through wavelet coherence (Grinsted et al., 2004). BAI is used as an indicator of forest productivity and is sensitive to stand dynamics and climatic changes [(4)].

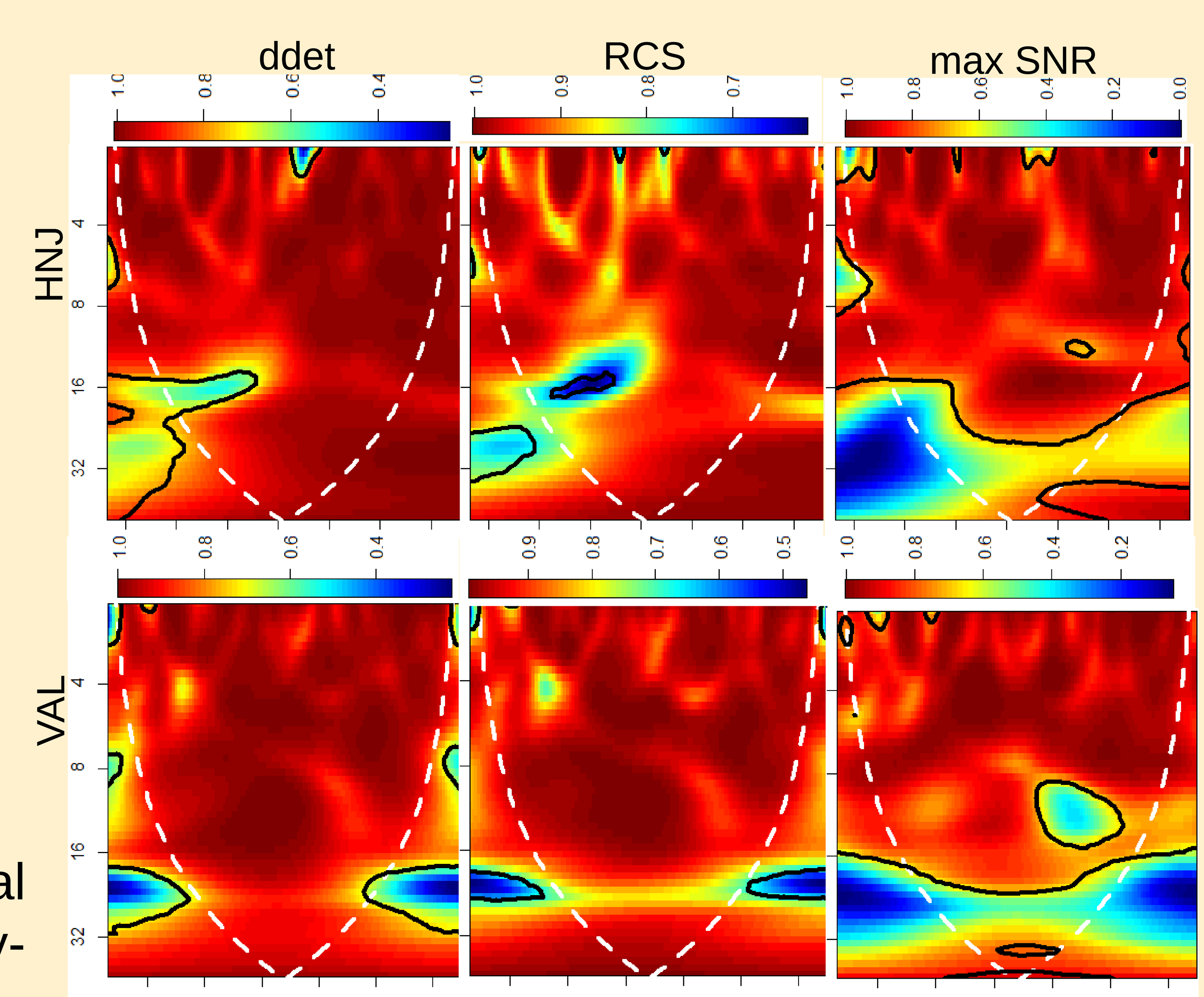
Results



When TR was used as single variable with criteria 1 and 2, dendroclimatic signal had lower resolution: there were differences in the correlation with spring/early-summer temperatures and spring and autumn rainfalls.

Coherence at low-frequencies between BAI and ddet and RCS master chronologies (criteria 1 and 2) was interpreted as conserved long-term climate change-related growth variability in the detrended series.





Concluding remarks

Although maximizing the high-frequency signal can be useful when calibrating climate-growth relationships, more conservative dentrending methods may be of interest in the study of low-frequency response to climatic changes. Using multiple variables of tree-ring growth and comparing signals from different detrending methods can be advisable.

(1) Holmes *et al.* (1986) Tree-Ring Chronologies of Western North America. Laboratory of Tree-Ring Research. *University of Arizona*

(2) Esper *et al.* (2003) Tests of the RCS Method for Preserving Low-Frequency Variability in Long Tree-Ring Chronologies. *Tree-Ring Research 59*

(3) Cook *et al.* (1990) Tree-ring standardization and growth-trend estimation. In: Cook & Kairiukstis (ed.) Methods of dendrochronology. *Kluwer Academic Publishers*

(4) Grinsted *et al.* (2004) Application of the cross wavelet transform and wavelet coherence to geophysical time series. *Nonlinear Proc Geophys 11*

(5) Gea-Izquierdo & Cañellas (2014) Local climate forces instability in long-term productivity of a Mediterranean oak along climatic gradients. *Ecosystems 17*

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