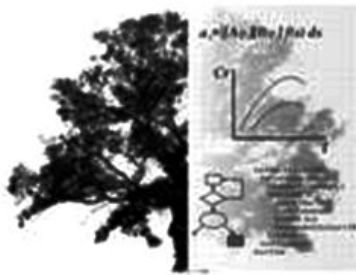


# EURODENDRO 2014

LUGO, SPAIN 8-12 SEPTEMBER

## **Plasticity in the dendroclimatic signal of *Pinus pinea* in connection to climate variability within the species distribution range**

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Departamento de  
Ciencias Agroforestales

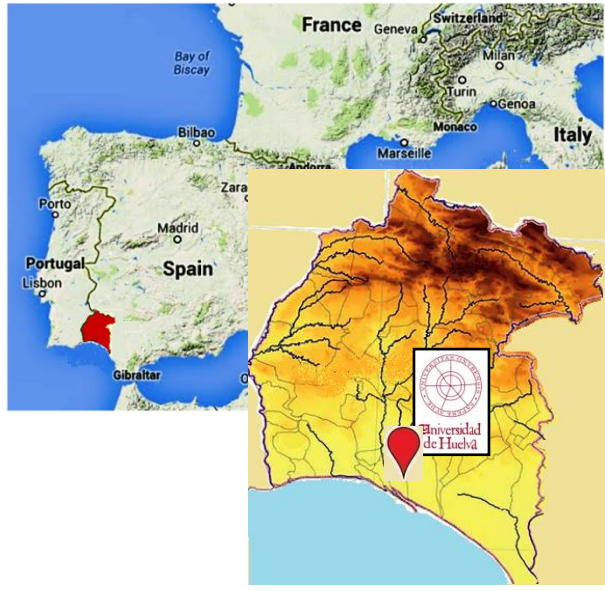


Grupo de investigación  
Análisis y Planificación del Medio Natural

Universidad  
de Huelva

# Background

Research team *Analysis and Management of Natural Environment*  
(Department of Agroforestry Science, Polytechnic School of Engineering,  
University of Huelva, Spain)



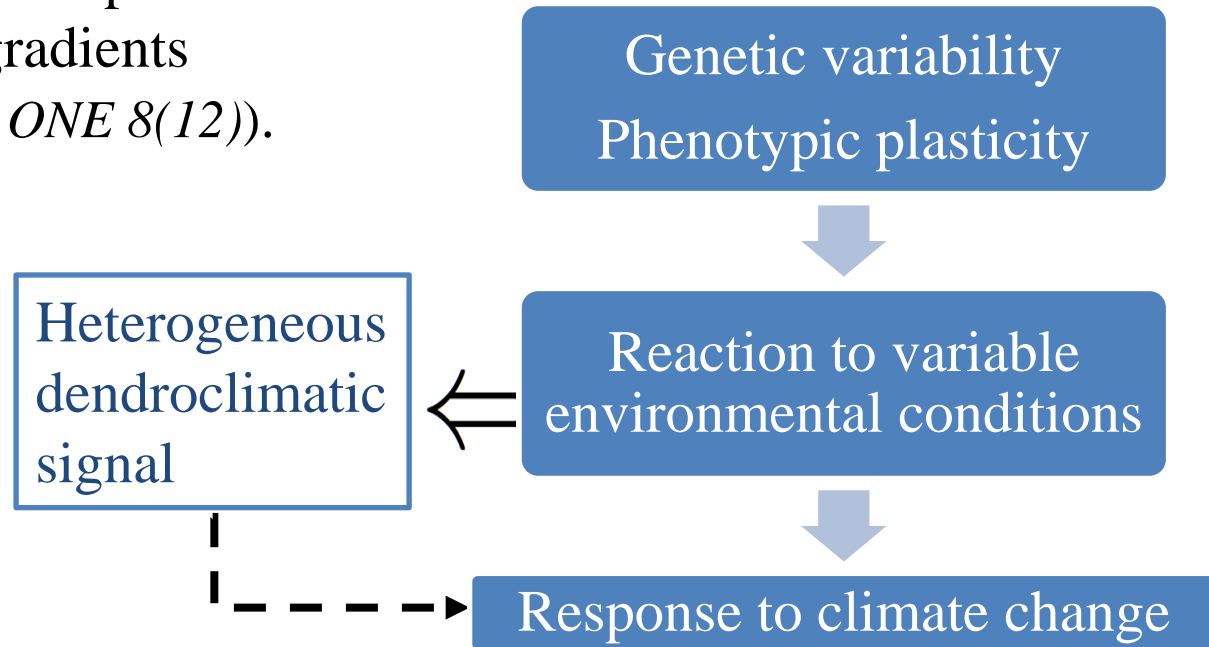
- Interests:
- Mediterranean forest ecosystems
  - Silviculture
  - Ecophysiology
  - **Dendroecology**



## Introduction – Context

Tree-ring growth and intra-annual anatomical characteristics exhibit site-specific relationships with climatic regimes (Novak *et al.*, 2013. *Trees* 27).

The dendroclimatic signal depends on the location along climatic gradients (de Luis *et al.*, 2013. *PLoS ONE* 8(12)).



## Introduction - Scopes

*What we present here...*

Development of a dendrochronological database of *Pinus pinea* integrating tree-ring data from Southwestern Spain and Central Italy.

*Intent of the database:*

Contributing to the investigation of the

*heterogeneous dendroclimatic signal of P. pinea across its geographical range.*

Heterogeneous dendroclimatic signal

Genetic variability  
Phenotypic plasticity

Reaction to variable environmental conditions

Response to climate change

*Specific objectives:*

Contrasting the climate-growth relationships of *P. pinea* in SW Spain and C Italy using tree-ring, earlywood and latewood chronologies.

## **1) DENDROCHRONOLOGICAL DATABASE**

### **1.1) Building new chronologies**

1.1.1) Location of sampling points

1.1.2) Sampling & measuring methods

### **1.2) Integrating database with open data**

### **1.3) Data processing**

1.3.1) Cross-dating

1.3.2) Standardization of tree-ring data

## **2) DENDROECOLOGICAL ANALYSIS**

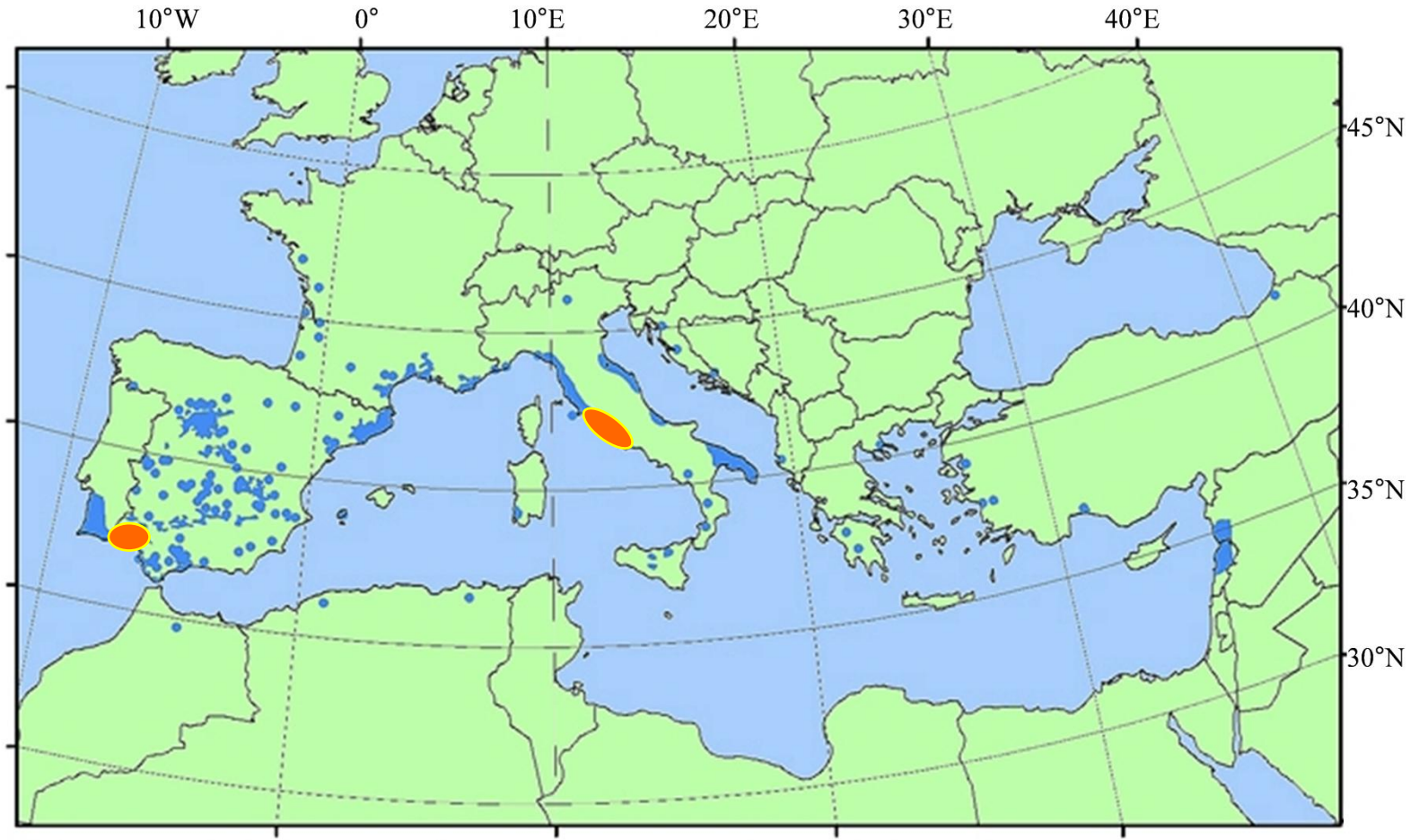
### **2.1) Meteorological data**

### **2.2) Climate-growth relationships**

# Dendrochronological database

# Dendrochronological database - Study sites (1) - newly collected samples

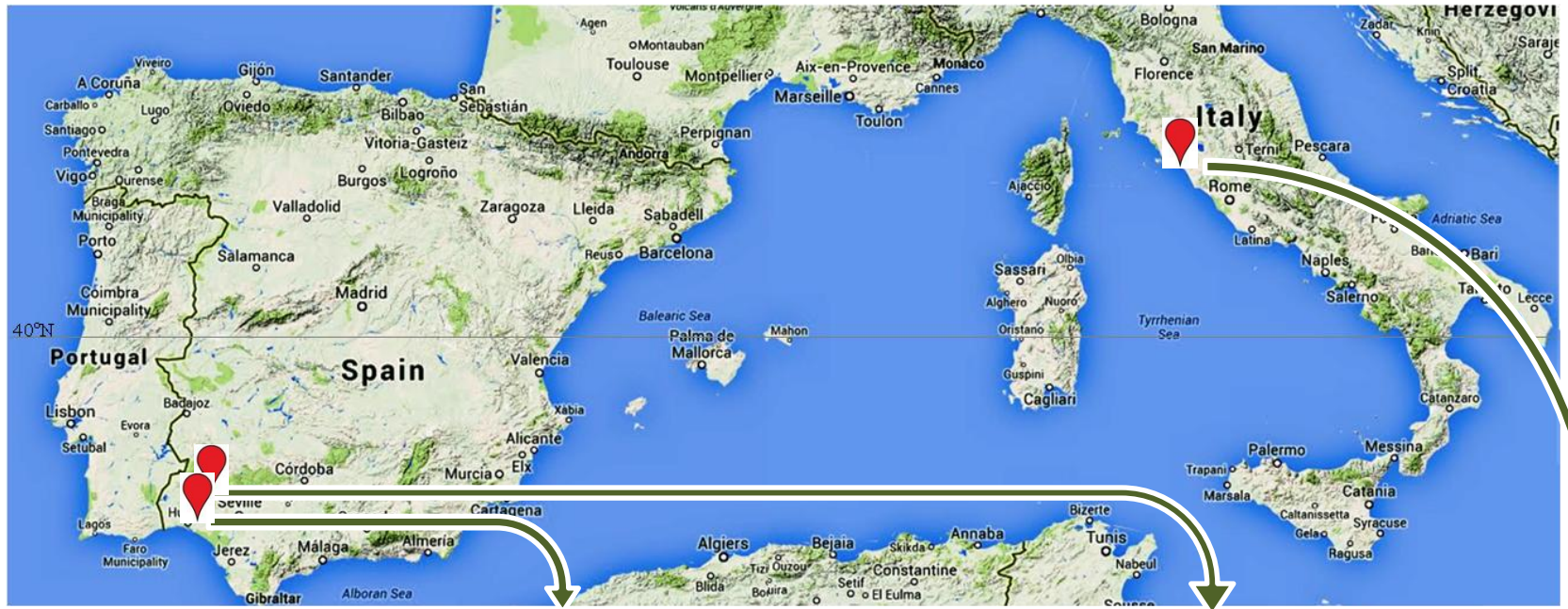
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Distribution map of Italian stone pine (*Pinus pinea*) EUFORGEN 2009, [www.euforgen.org](http://www.euforgen.org).



# Dendrochronological database - Study sites (1) - newly collected samples



Site code	ELP	PUM	MAZ	MOG	CCO	HNJ	PVA	TAR
Position	Coastal				Inland			Coastal
Soil cover	Opened/ closed canopy				Closed canopy			
Altitude	0	0	0	30	140	70	260	0-10
Mean diam	22±8.7	28±7.9	29±11.0	55±9.2	67±7.9	72±8.2	62±6.9	28±2.0
Mean height	5±1.4	7±1.7	5±1.8	17±3.7	22±1.4	20±1.7	19±3.1	10±1.1

# Newly collected samples – Sampling, measuring & cross-dating



## Type of data

- Tree-ring width (TR)
- Earlywood width (EW)
- Latewood width (LW)



	Samples	
	No. of trees	No. of cores
ELP	20	40
CCO	17	34
HNJ	19	38
MAZ	23	46
MOG	17	34
PUM	17	34
PVA	20	40
TAR	18	36

(tot.) 151 302

## Cross-dating



- ✓ *Gleichläufigkeit* (Glk)
- ✓ Pearson's *r*
- ✓ *t*-value (TV)
- ✓ COFECHA
- ✓ cross-date index (CDI)
- (Grissino-Mayer, 2001)

# Dendrochronological database - Study sites (2) - open data

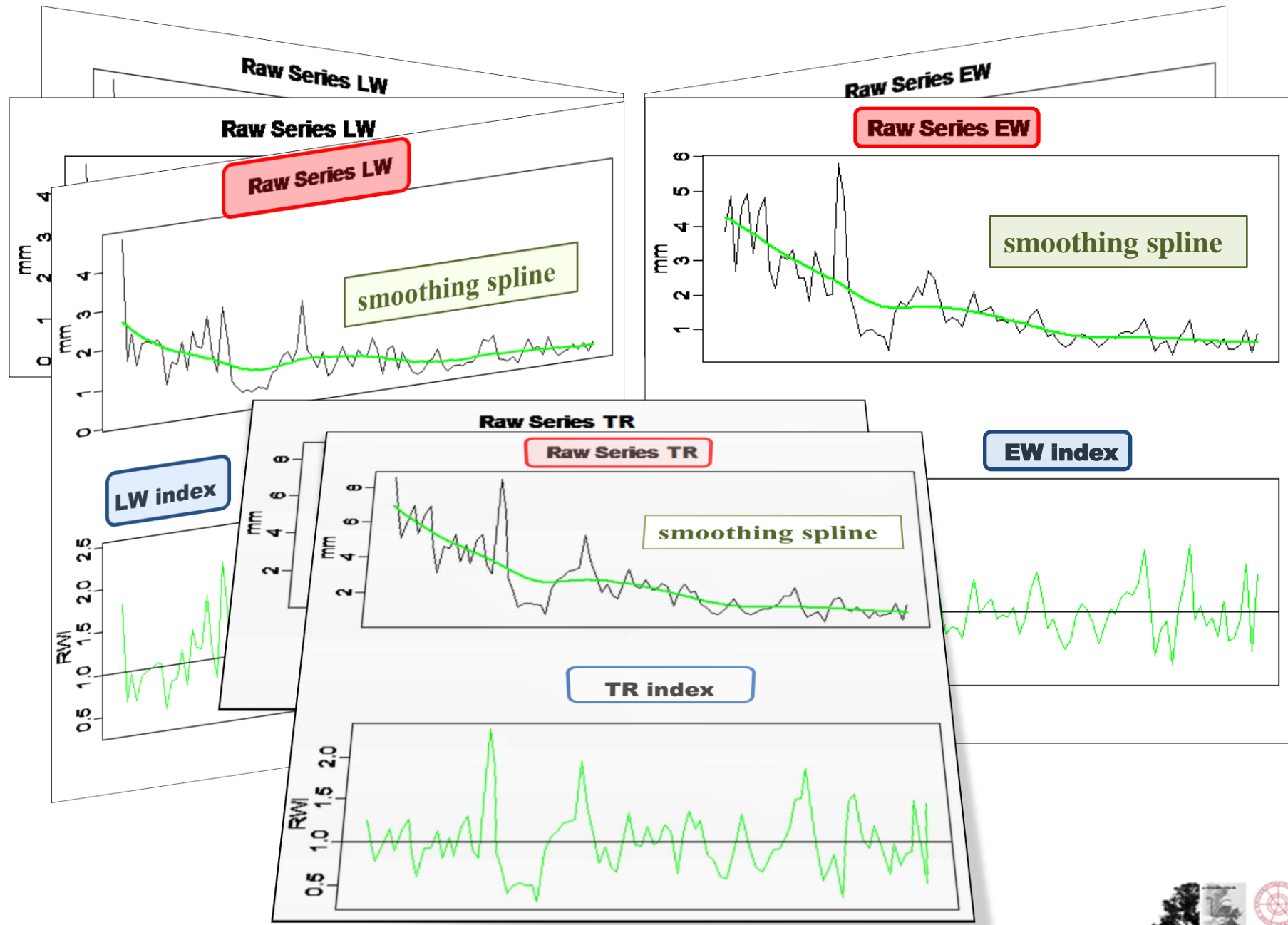


Site code	ELP	PUM	MAZ	MOG	CCO	HNJ	PVA	TAR		ital002
Position										coastal
Altitude										0
									Source	ITRDB
									Author	Biondi F.
									Data type	TR

Content of the ital002 directory:

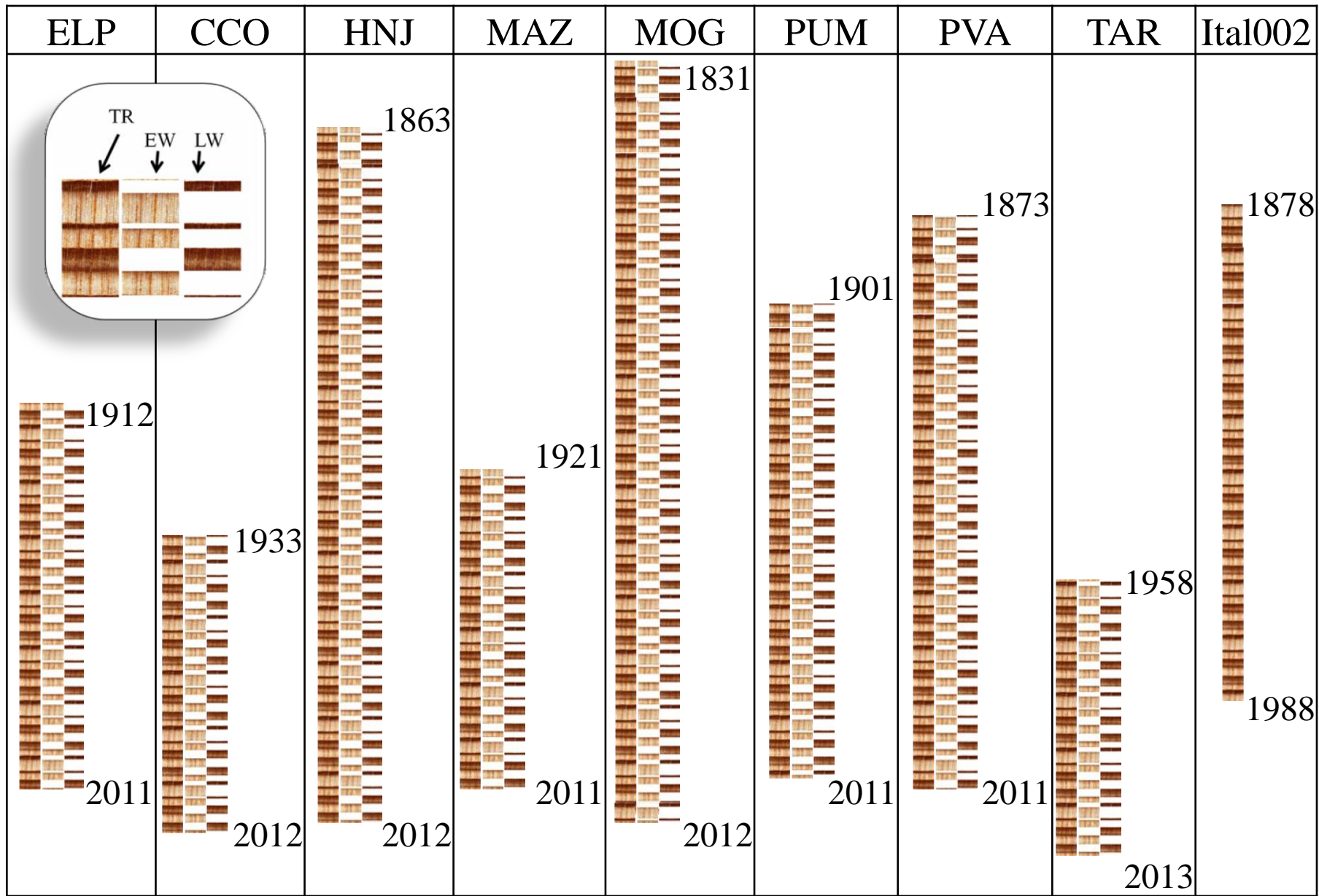
- Cross-dating result (COFECHA output)
- Raw TR measurements (Tuscon format, '.rwl')

# Dendrochronological database - Data processing (standardization of raw series)



# Dendrochronological database - Index series

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# **Dendroecological analyses**

# Dendroecological analyses - Rationale



Dendroecological analysis

- Growth indexes
  - Meteorological data
- Climate-growth relationships

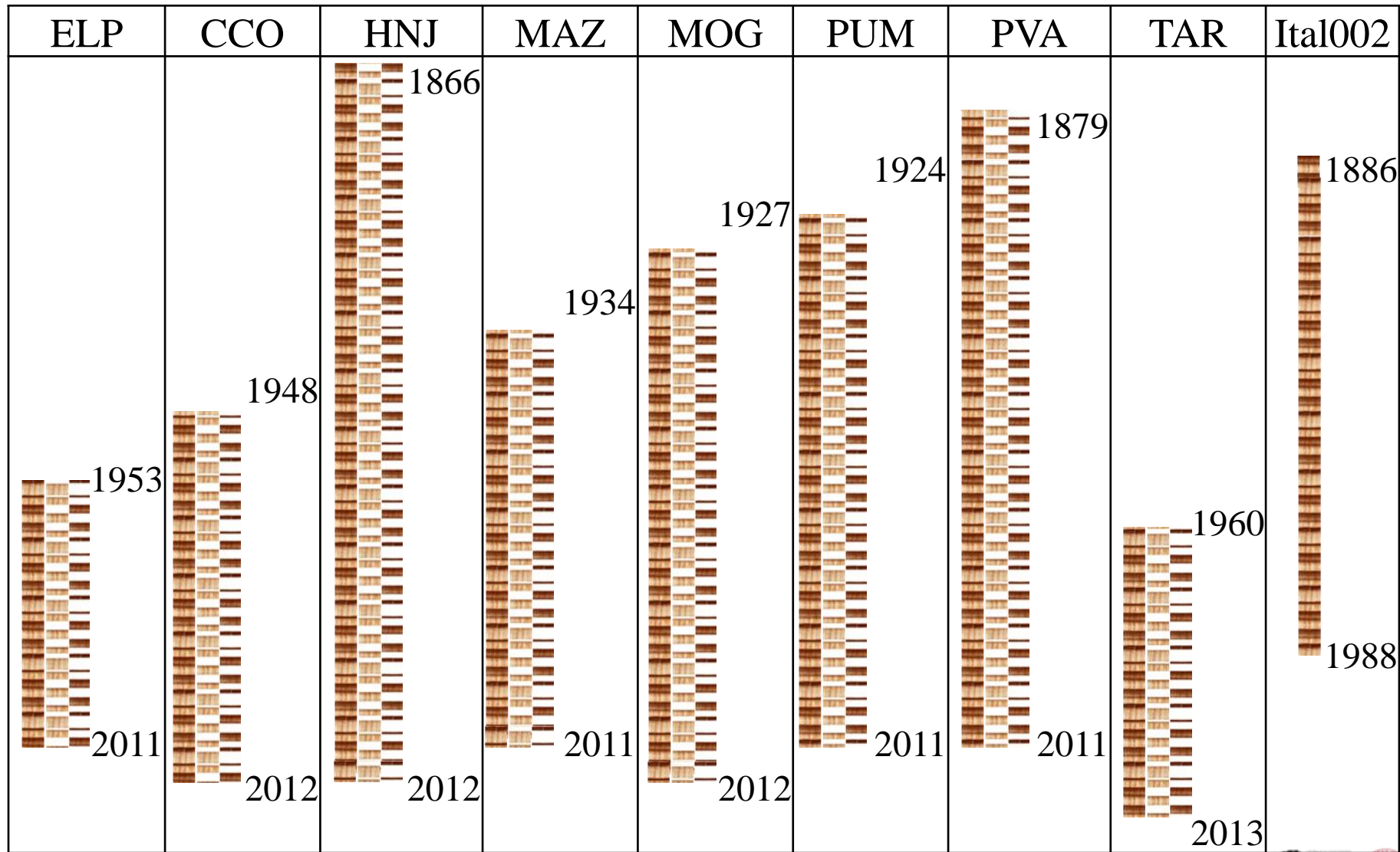
Dendroecological analysis

- Growth indexes
  - Meteorological data
- Climate-growth relationships

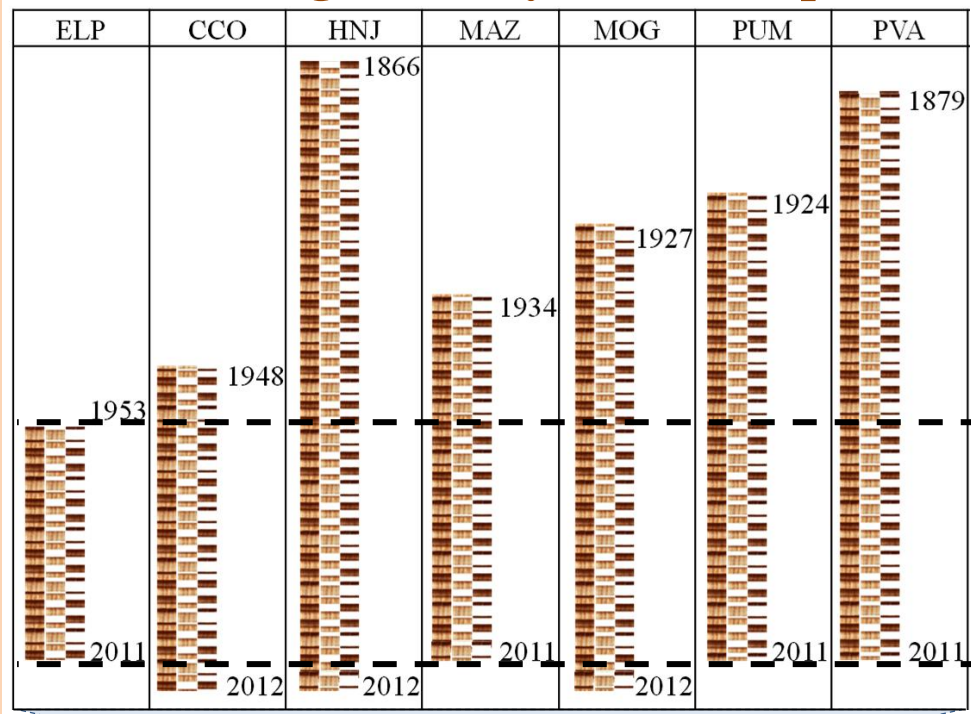
Contrast

## Dendroecological analyses – Used index series

Usable length of each indexed chronology (TR, EW, LW) for dendroecological analysis (criteria: sample depth  $\geq 5$ ; EPS  $\geq 0.85$ )



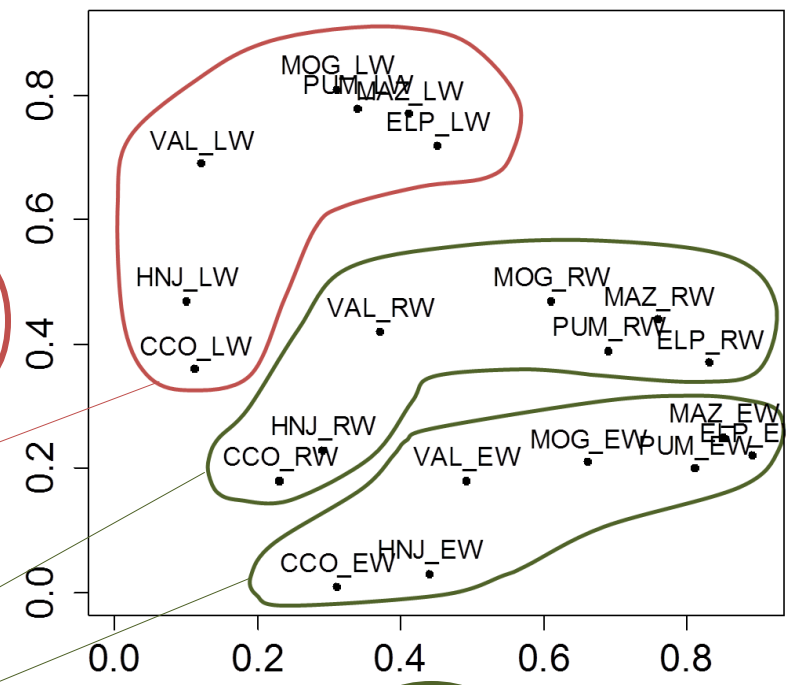
# Dendroecological analyses - Principal components of Spain chronologies



Principal component analysis of the correlation matrix.

% of variance in the first two components: 70.98

Component plot

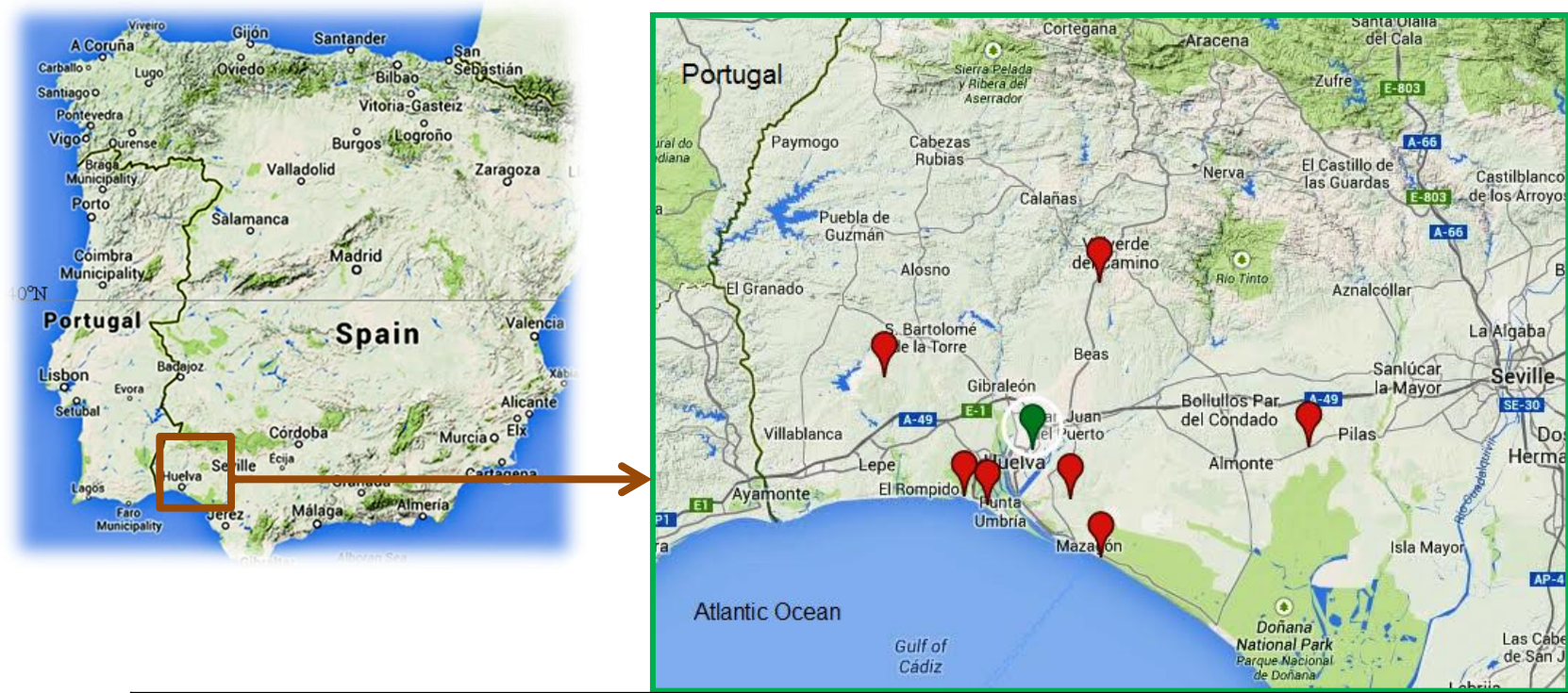




PC1 (TR, EW)	PC2 (LW)
1953	1953
↓	↓
2011	2011

Used eigenvectors



# Dendroecological analyses - Meteorological data (1)



 Sites	Polygon area: 1700 km <sup>2</sup>
 Meteorological station “Huelva ronda del este” coordinates: 37.28N, -6.91E, 19.0m time span: 1921-2012	Mean distance between meteo station and sites: 22 km

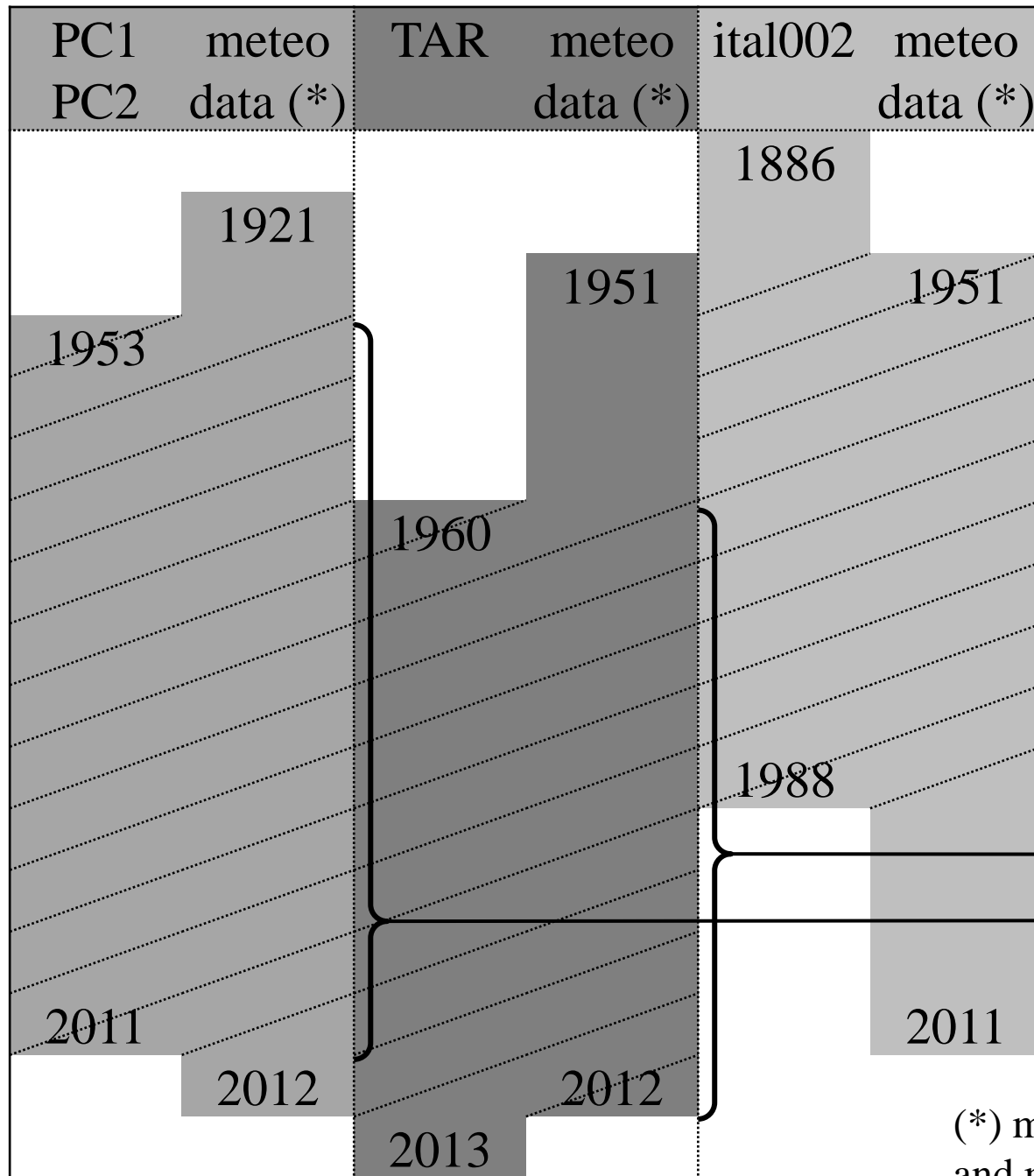
## Dendroecological analyses - Meteorological data (2)



<p><b>TAR</b></p> <p>Distance from meteo station: 10km</p> <p>📍 Meteo station “Tarquinia”: 42.25N, 11.74E; 11m time span: 1952-2013</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="3" style="text-align: center;"> <b>TAR</b> </td> <td colspan="2" style="text-align: center;"> <b>ital002</b> </td> </tr> <tr> <td style="width: 20%;">TR indexes</td> <td style="width: 20%;">EW indexes</td> <td style="width: 20%;">LW indexes</td> <td colspan="2" style="width: 40%;">TR indexes</td> </tr> </table>	<b>TAR</b>			<b>ital002</b>		TR indexes	EW indexes	LW indexes	TR indexes		<p><b>Ital002</b></p> <p>Distance from meteo station: 20km</p> <p>📍 Meteo station “Latina”: 41.47N, 12.90E; 20m time span: 1951-2011</p>
<b>TAR</b>			<b>ital002</b>									
TR indexes	EW indexes	LW indexes	TR indexes									

# Dendroecological analyses - Climate-growth relationships

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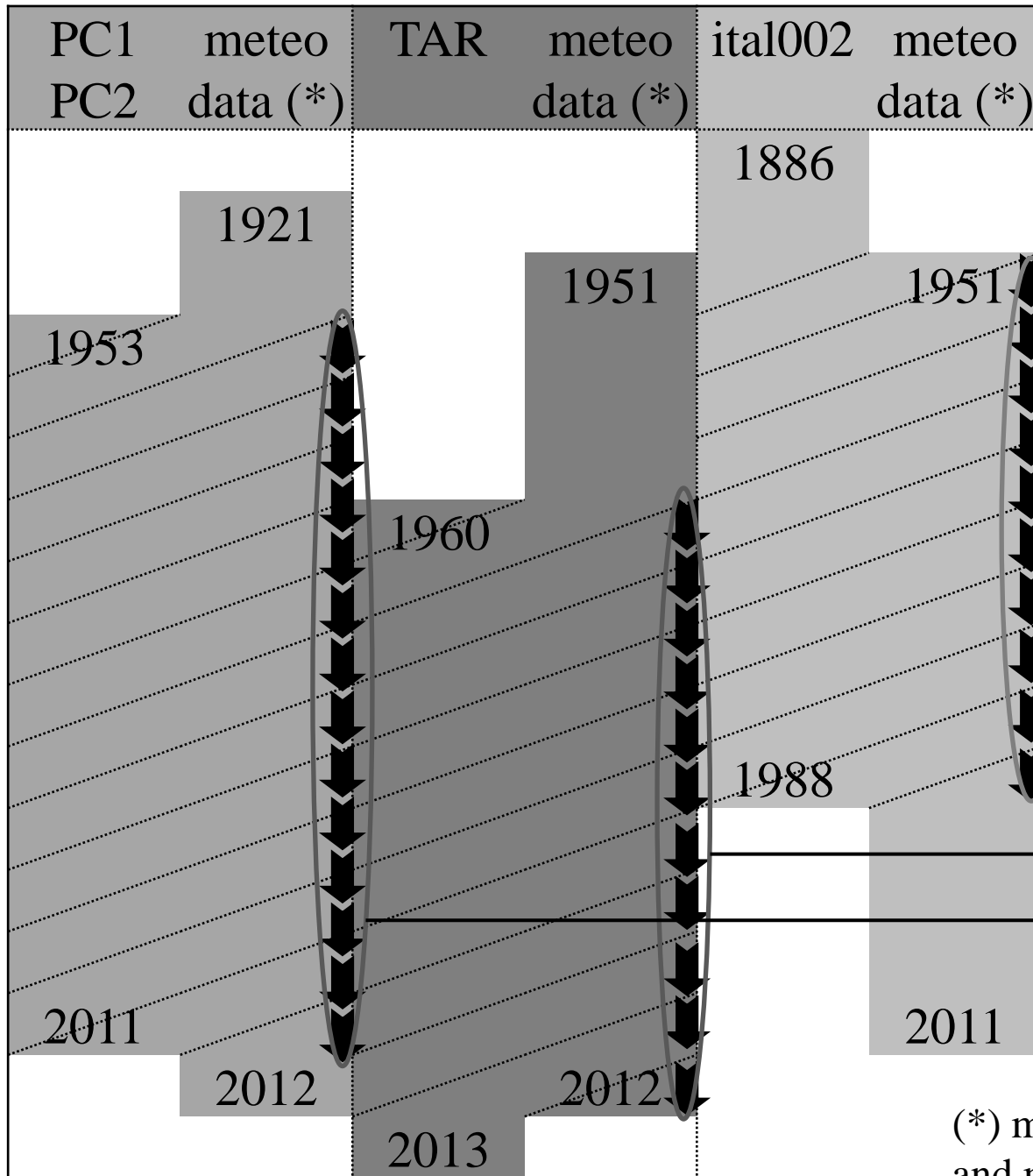
Correlation analysis (Pearson  $r$ ,  $\alpha=0.05$ ) between series and meteorological data for the common intervals

(\*) monthly precipitation and mean temperatures



# Dendroecological analyses - Climate-growth relationships

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Correlation analysis (Pearson  $r$ ,  $\alpha=0.01$ ) for running windows (25 years) between series and meteorological data over the common intervals

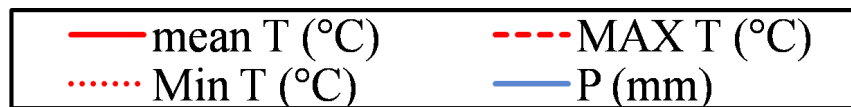
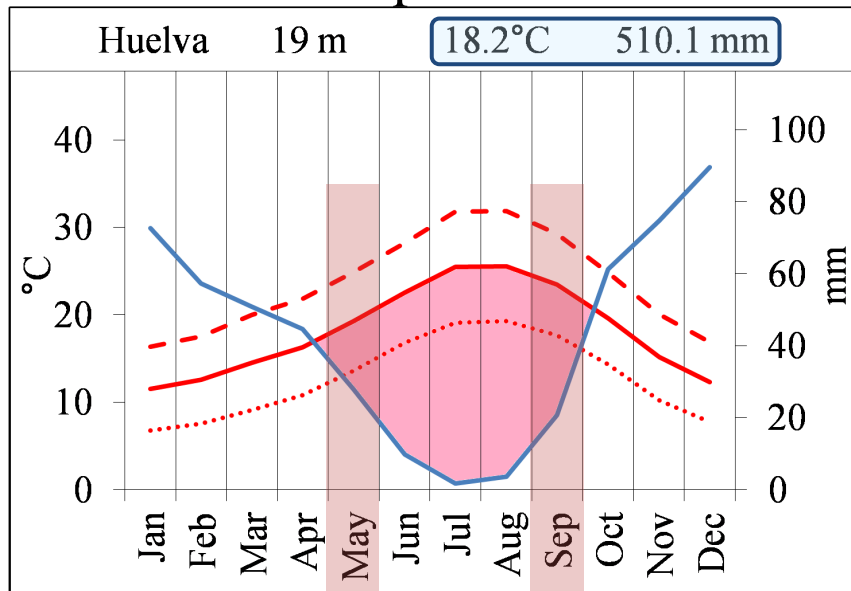
(\*) monthly precipitation and mean temperatures



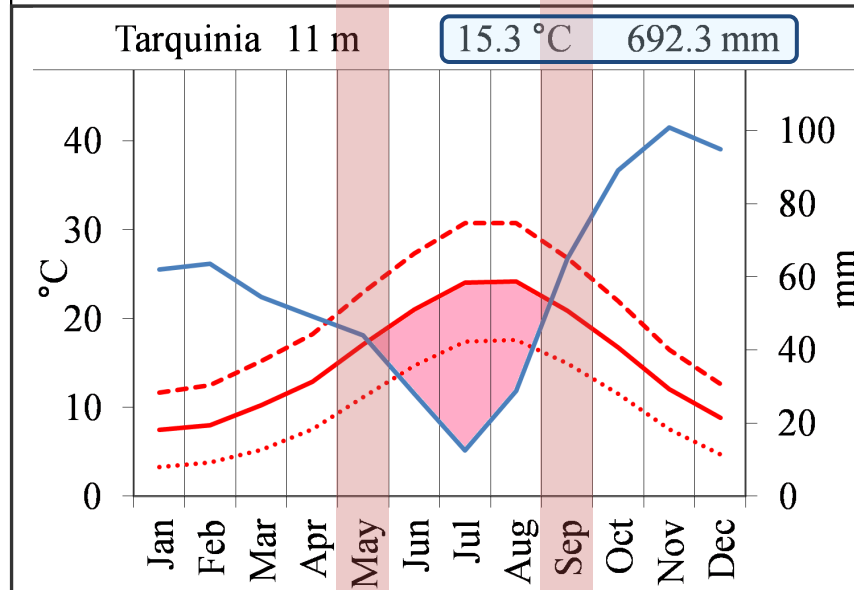
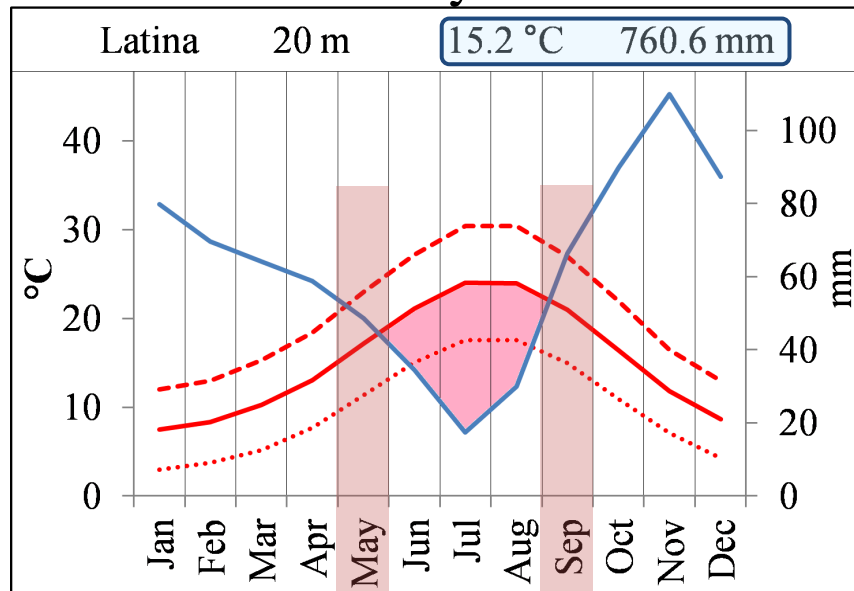
## **Results & discussion**

# Results - Climate

## Spain



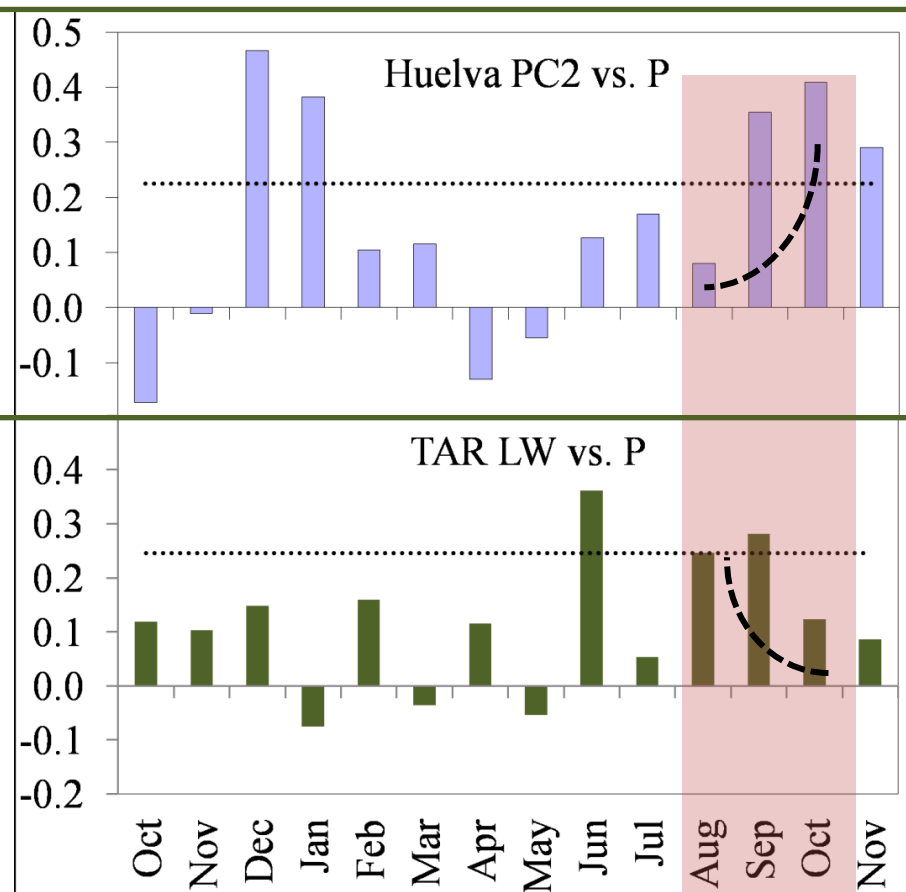
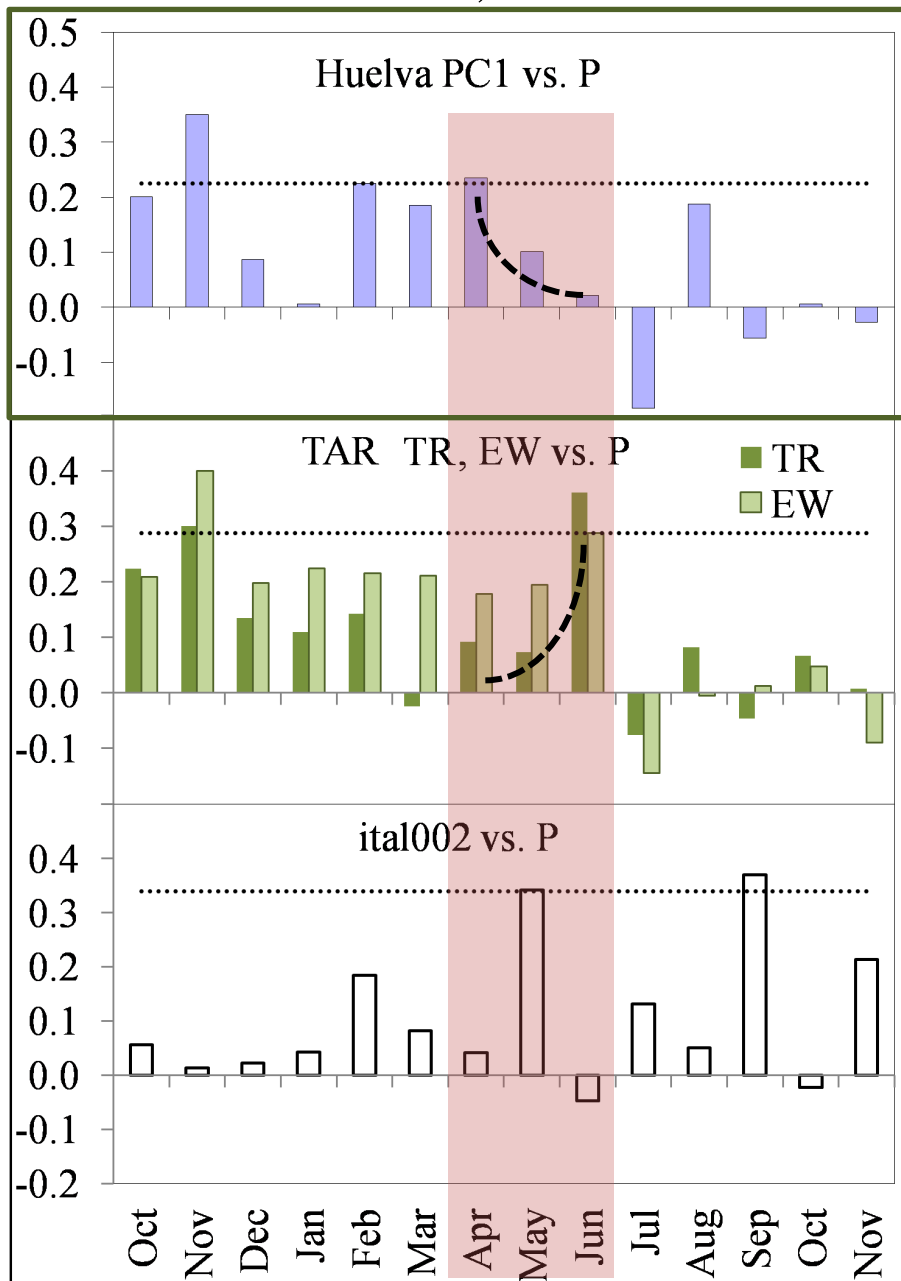
## Italy



# Results – Tree response to rainfall

TR, EW

LW

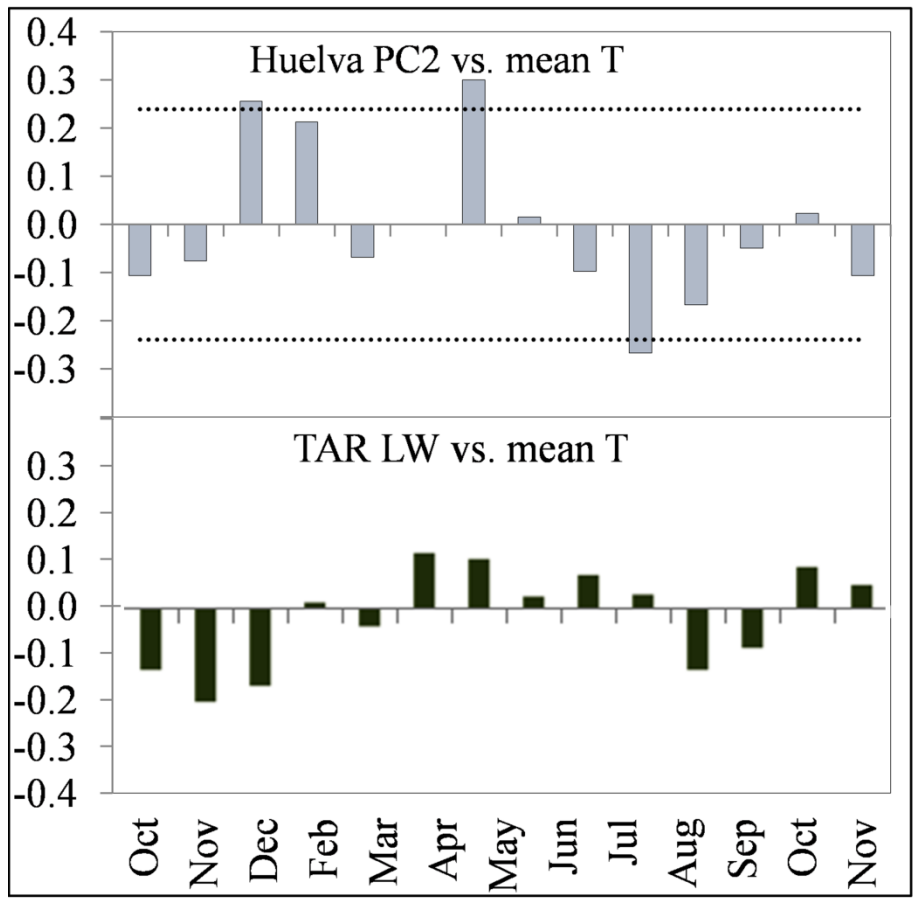
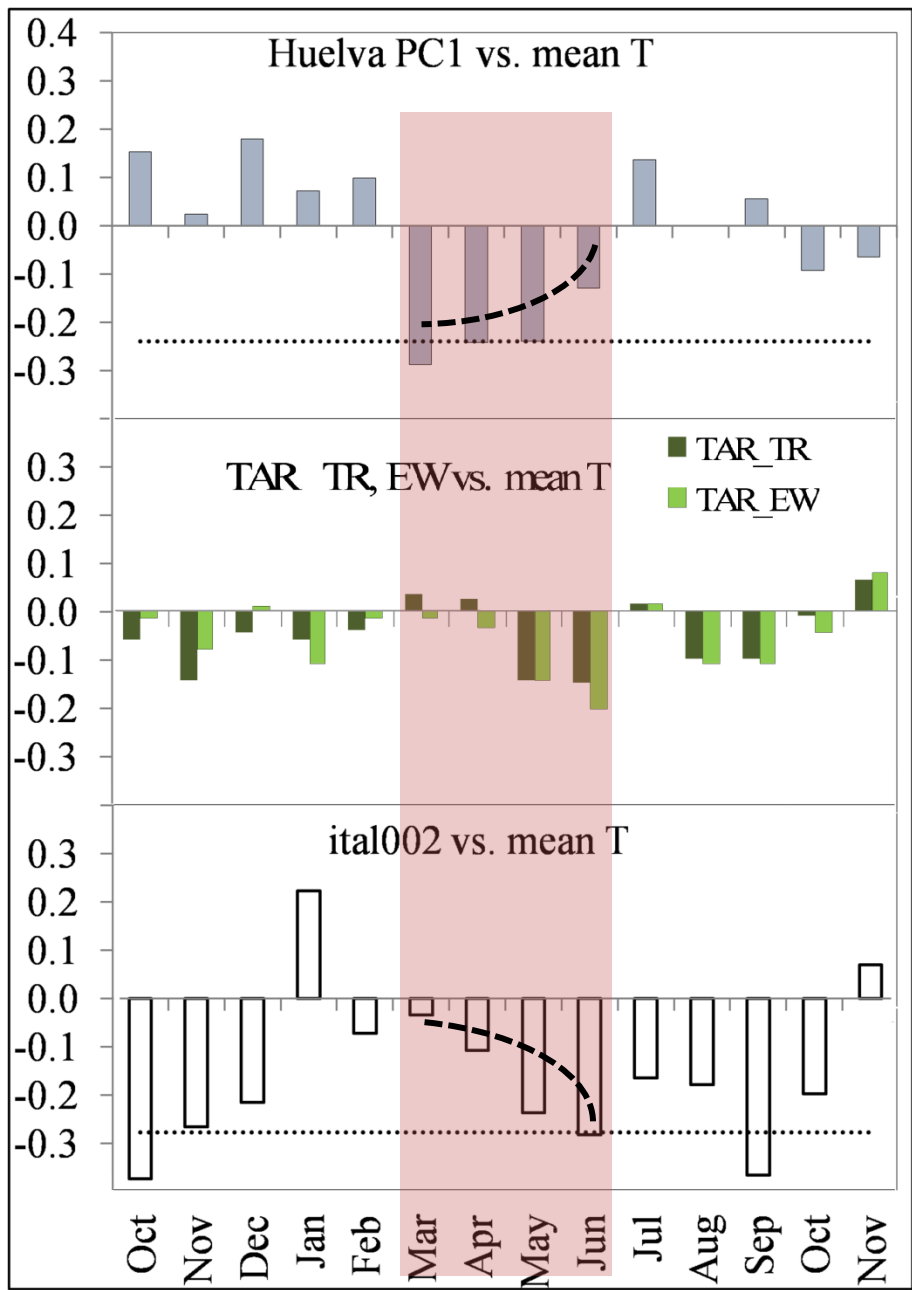


(horizontal dotted lines:  $p < 0.05$ )



# Results - Tree response to temperatures

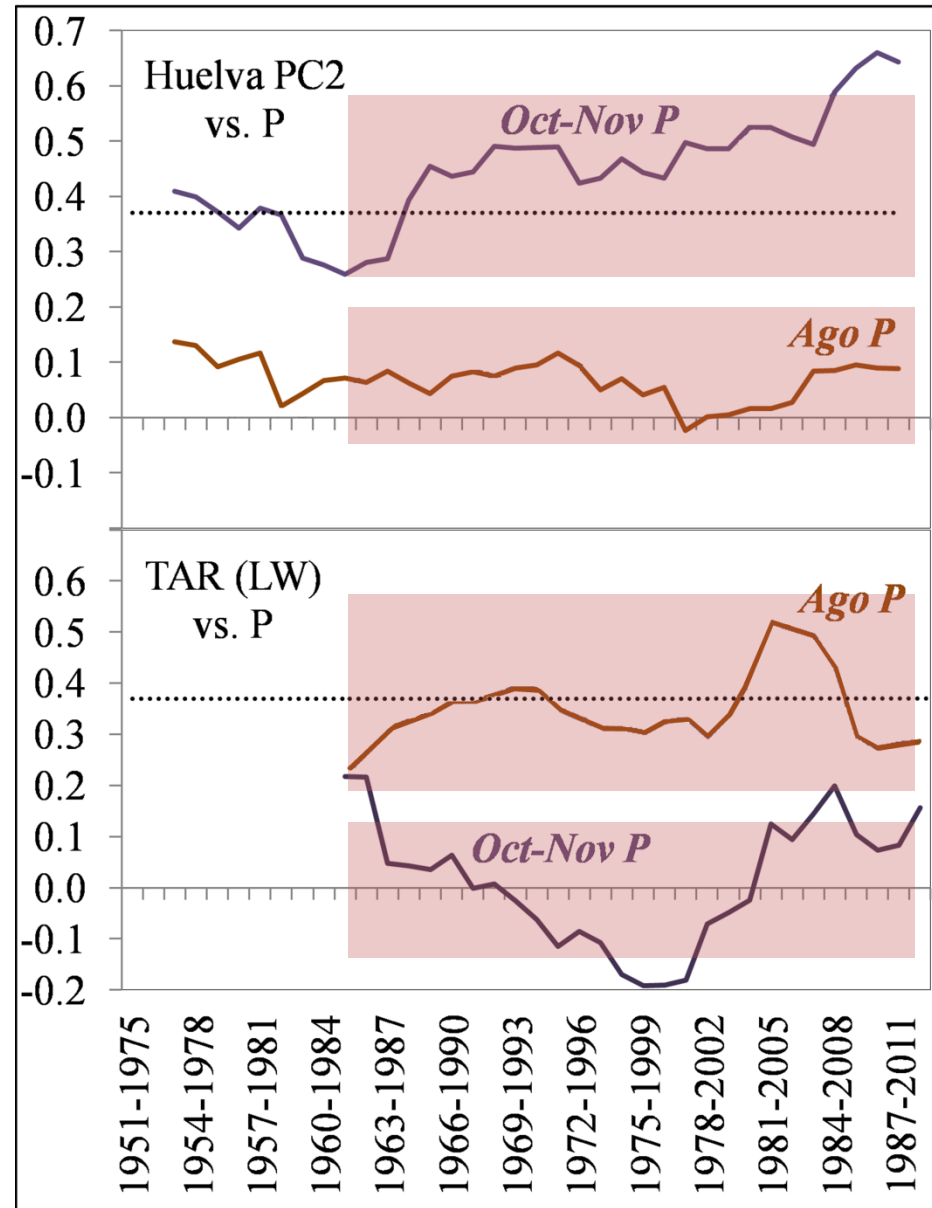
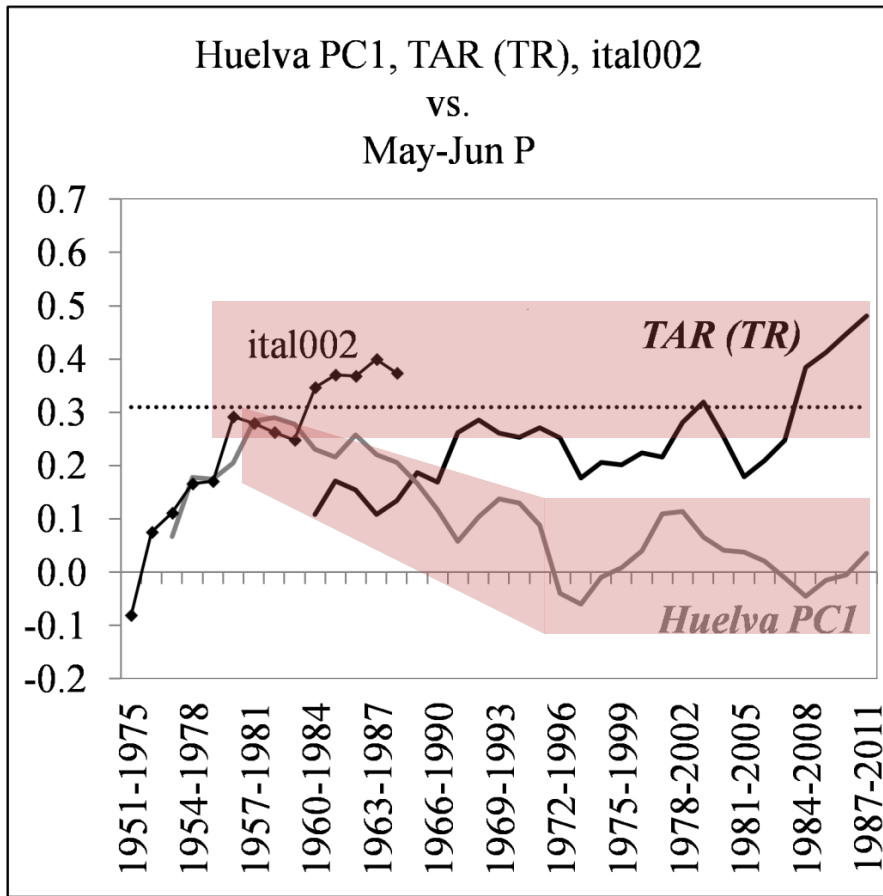
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(horizontal dotted lines:  $p < 0.05$ )



# Results – Climate-growth relationships over time



(horizontal dotted lines:  $p < 0.01$ )



**Conclusions,  
perspectives  
&  
implications**

## Concluding remarks

We provide a dendrochronological database of *P. pinea* including SW Spain, where long chronologies for this species were not available before.

Ring formation and intra-annual wood differentiation show plasticity linked to the local climatic regimes and are sensitive to the extent of the dry season.

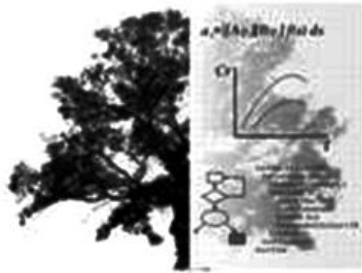
Although climate-growth relationships showed changes over time within regions, the difference between regions in the sensitivity to the extent of the dry season remained consistent.

## Perspectives

Including wider datasets to assess the plastic response of *P. pinea* to the variable Mediterranean climate at larger scale.

## Implications

- Adjustable phenology in connection to temperature gradients.
- Diverse susceptibility of populations to atmospheric warming depending on their location.
- Capacity of the species to cop with climate-change induced stress.



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