



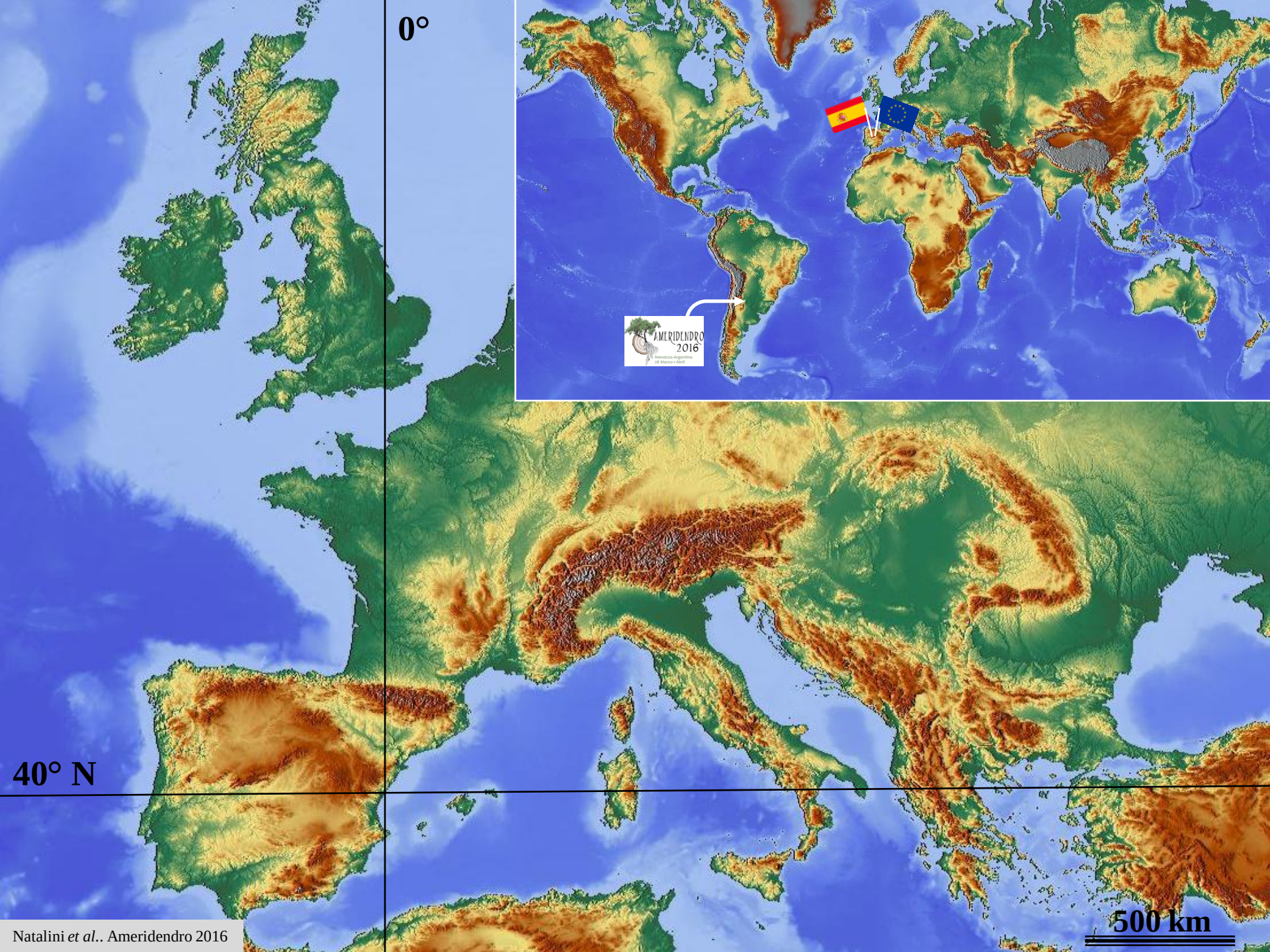
Diverse growth-climate relationships and response to climate change in Mediterranean pine woodlands in the Iberian Peninsula

NATALINI Fabio, VÁZQUEZ-PIQUÉ Javier, ALEJANO Reyes

Research group
“Análisis y Planificación
del Medio Natural”

Department of Agroforestry
University of Huelva (Spain)



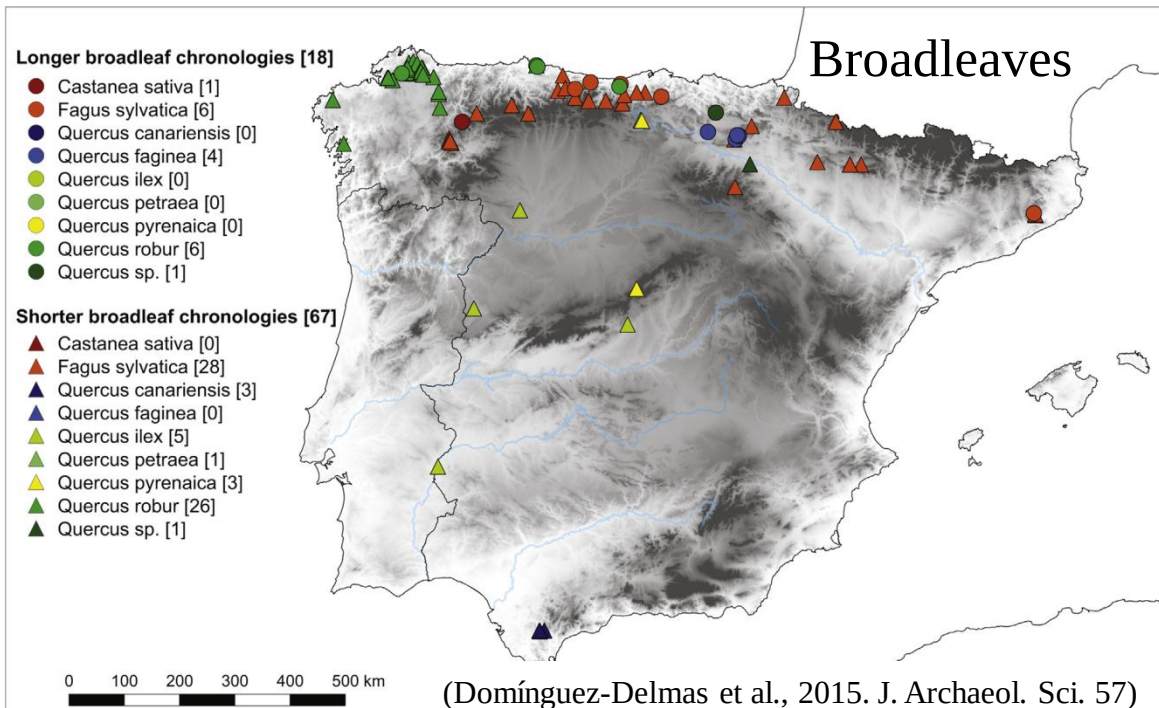
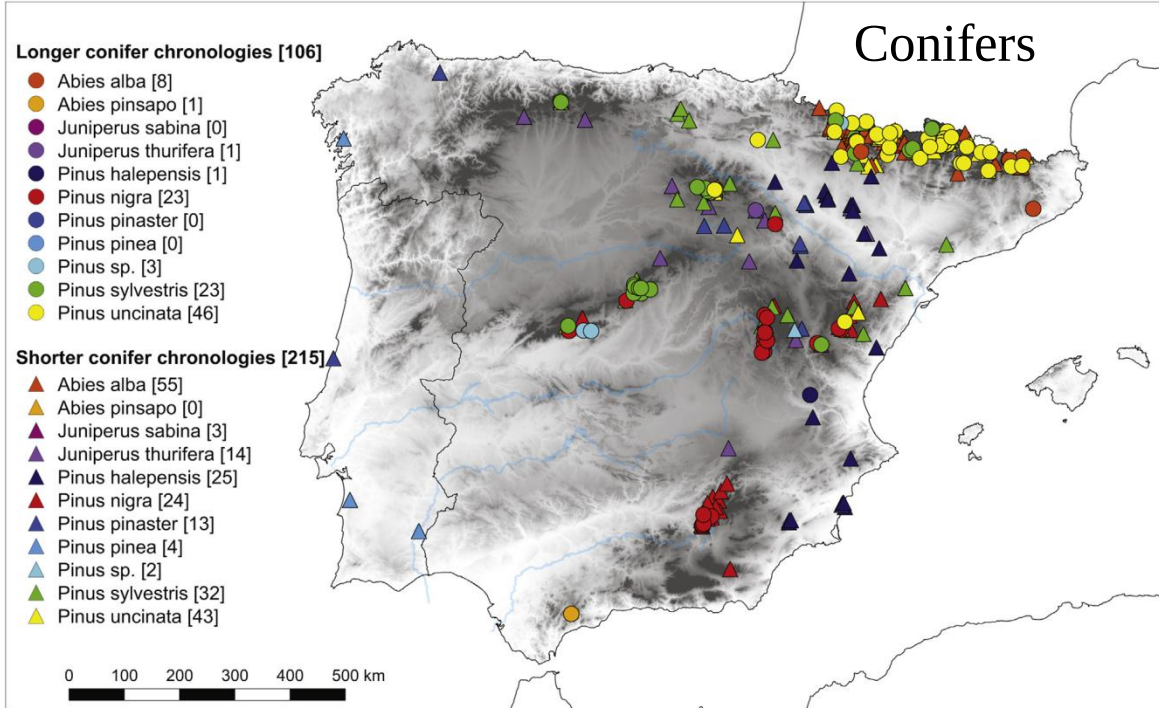


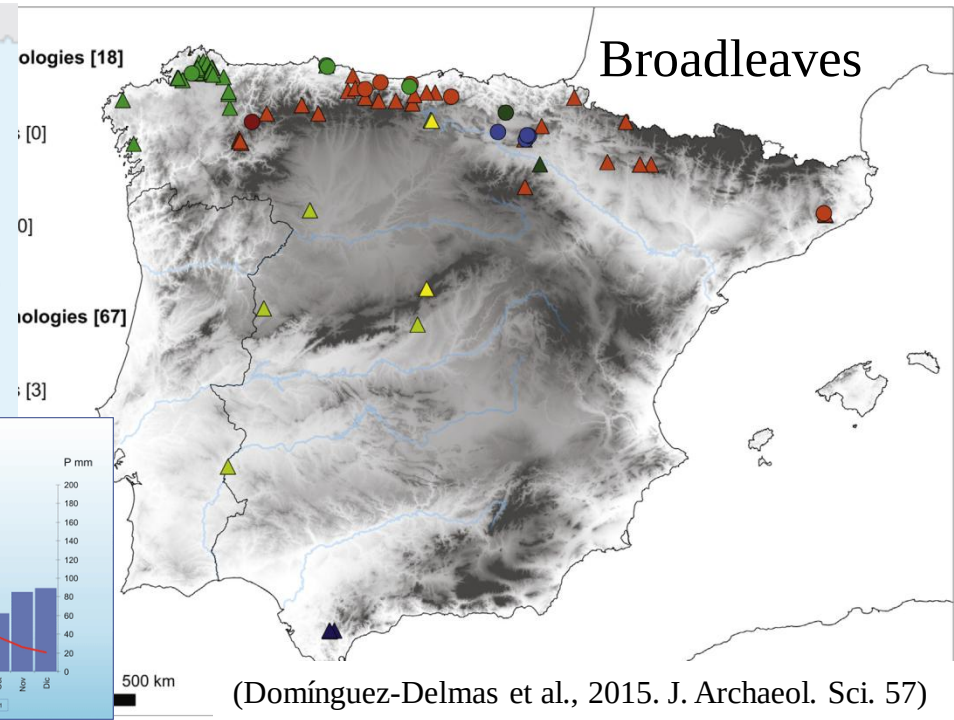
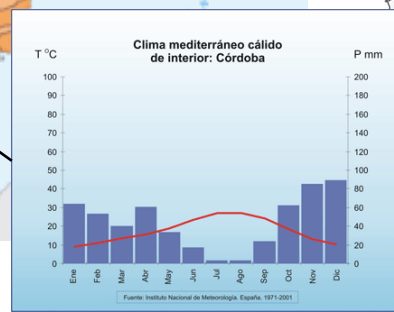
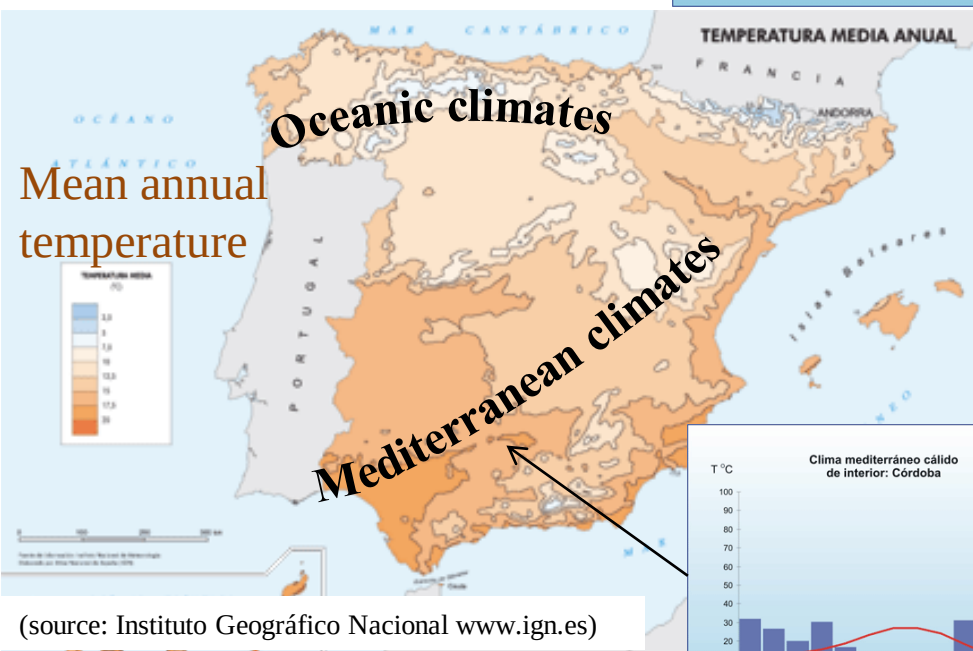
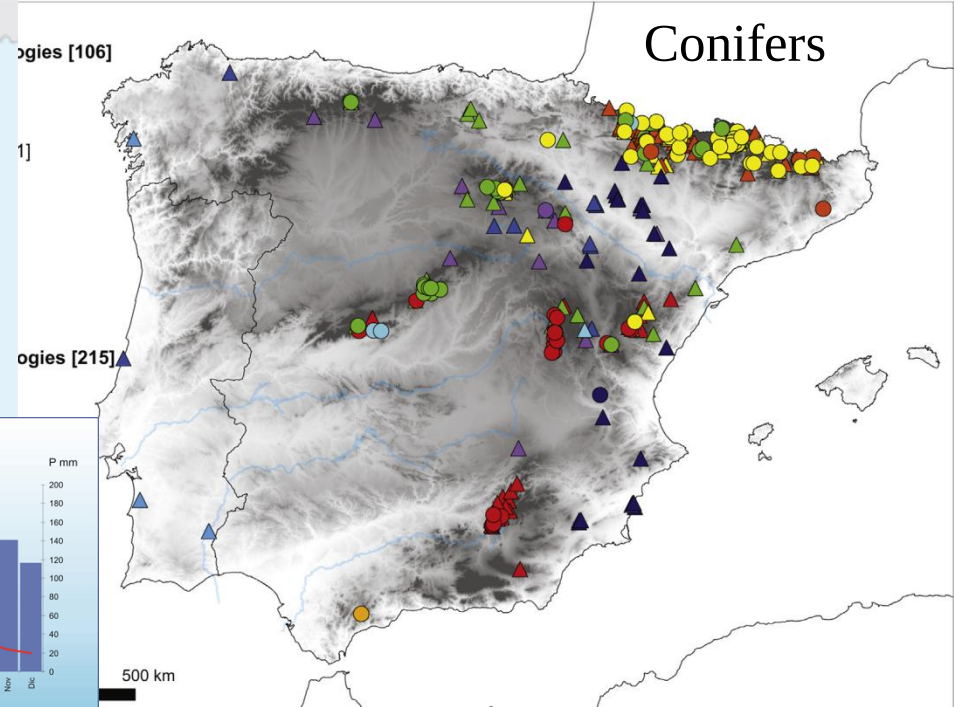
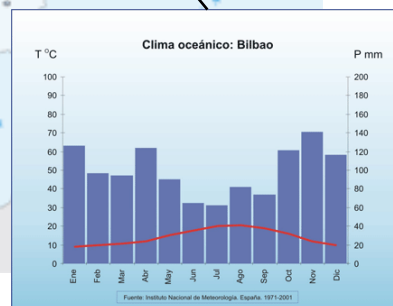
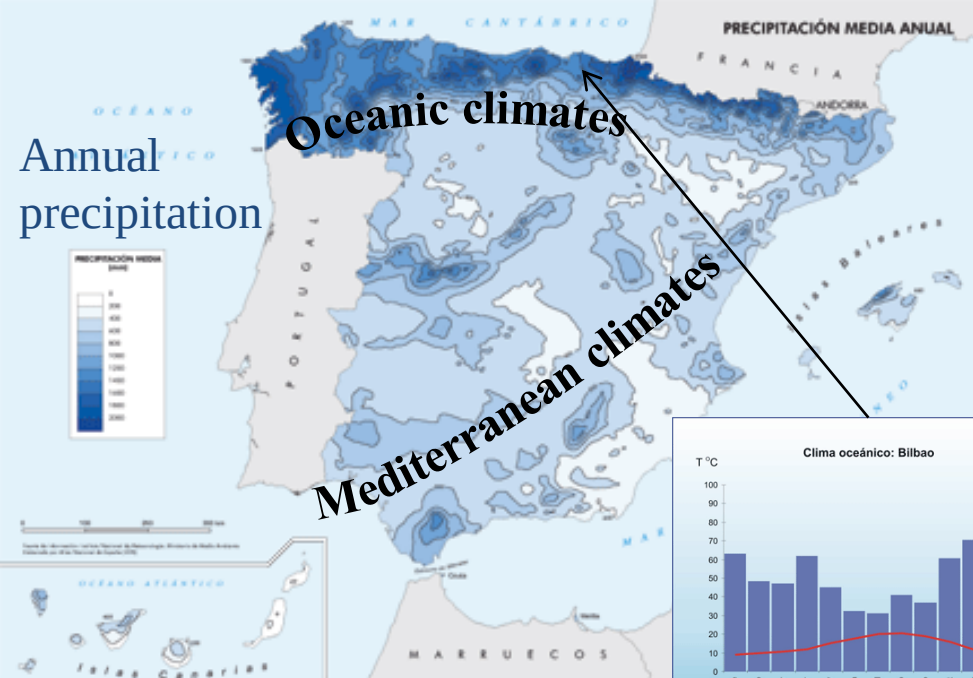
0°



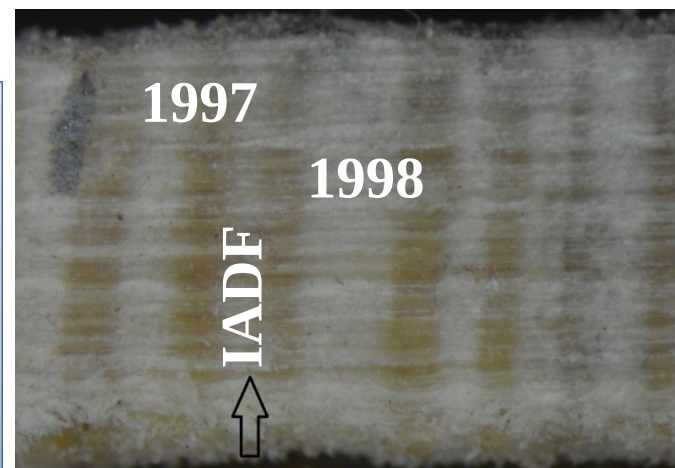
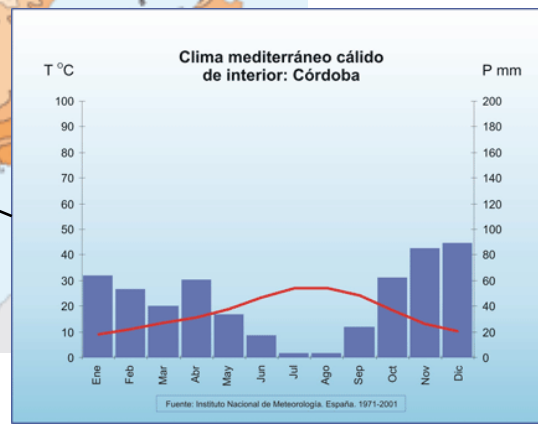
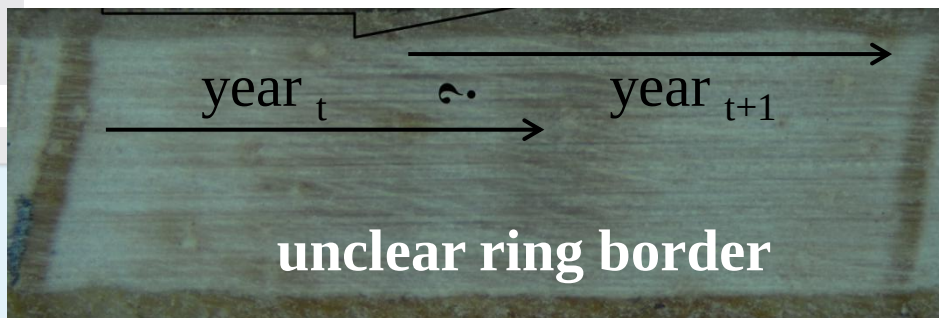
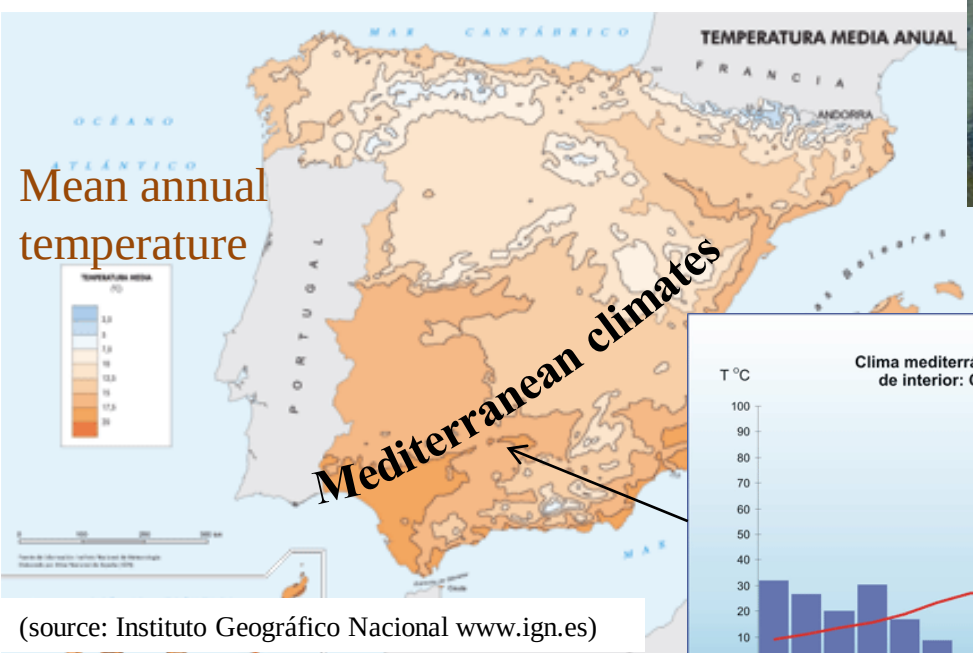
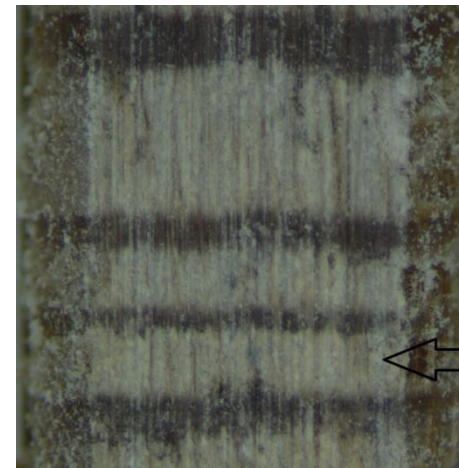
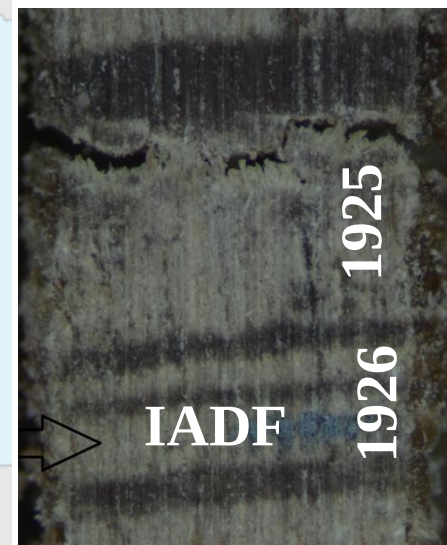
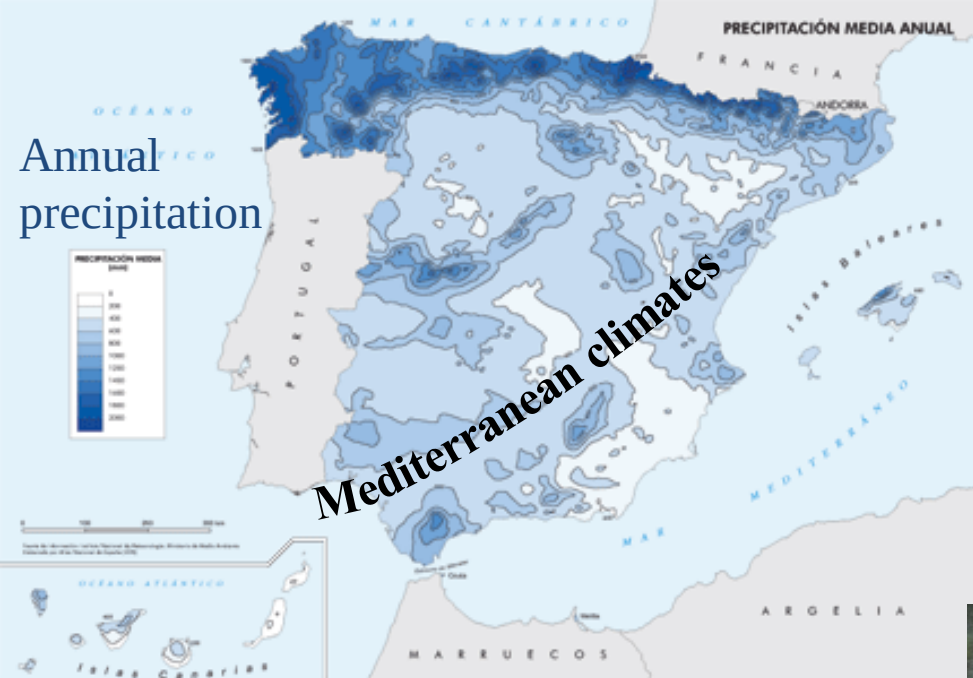
40° N

500 km





(source: Instituto Geográfico Nacional www.ign.es)



Identification, measurement and interpretation of tree rings in woody species from mediterranean climates

PAOLO CHERUBINI¹*, BARBARA L. GARTNER², ROBERTO TOGNETTI³, OTTO U. BRÄKER¹, WERNER SCHOCH¹ and JOHN L. INNES⁴

¹ Swiss Federal Institute for Forest, Snow and Landscape Research WSL, CH-8903 Birmensdorf, Switzerland and Lamont–Doherty Earth Observatory, Columbia University, Palisades, New York 10964, USA

Forest Ecology and Management 320 (2014) 70–82

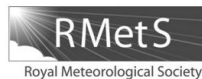


Drought induced decline could portend widespread pine mortality at the xeric ecotone in managed mediterranean pine-oak woodlands

Guillermo Gea-Izquierdo^{a,b,*}, Bárbara Viguera^a, Miguel Cabrera^c, Isabel Cañellas^a

^a INIA-CIFOR, Ctra. La Coruña km 7.5, 28040 Madrid, Spain
^b CEREGE UMR 7230, CNRS/Aix-Marseille Université, Europe de l'Arbois, BP 8013545, Aix-en-Provence cedex 4, France
^c Aranzada Gestión Forestal S.L.P., C/Alonso Heredia, 31, 28028 Madrid, Spain

INTERNATIONAL JOURNAL OF CLIMATOLOGY
Int. J. Climatol. (2014)
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/joc.4137



Climate sensitivity of Mediterranean pine growth reveals distinct east–west dipole

Andrea Seim,^{a,b,*} Kerstin Treydte,^b Valerie Trouet,^c David Frank,^{b,d} Patrick Fonti,^b Willy Tegel,^c Momchil Panayotov,^f Laura Fernández-Donado,^{g,h} Paul Krusicⁱ and Ulf Büntgen^{b,d,j}

Climate Dynamics (2005) 25: 75–98
DOI 10.1007/s00382-005-0016-5

Ramzi Touchan · Elena Xoplaki · Gary Funkhouser
Jürg Luterbacher · Malcolm K. Hughes · Nesat Erkan
Ünal Akkemik · Jean Stephan

Reconstructions of spring/summer precipitation for the Eastern Mediterranean from tree-ring widths and its connection to large-scale atmospheric circulation

Ann. For. Sci. 67 (2010) 401
© INRA, EDP Sciences, 2010
DOI: 10.1051/forest/2009121

Available online at:
www.afs-journal.org

Original article

Black pine (*Pinus nigra* Arn.) growth divergence along a latitudinal gradient in Western Mediterranean mountains

Darío MARTÍN-BENITO^{*}, Miren del RÍO, Isabel CAÑELLAS

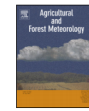
Centre for Forest Research, CIFOR-INIA, Ctra. La Coruña, km 7.5, 28040 Madrid, Spain



Contents lists available at ScienceDirect

Agricultural and Forest Meteorology

journal homepage: www.elsevier.com/locate/agrformet



What drives growth of Scots pine in continental Mediterranean climates: Drought, low temperatures or both?



Raúl Sánchez-Salguero^{a,b,*}, J. Julián C. Linares^a, Juan A. Ballester-Raquel Alfaro-Sánchez^a, Gabriel Emilia Gutiérrez^a, Mar Génova^k

Ann. For. Sci. 64 (2006) 229–238
© INRA, EDP Sciences, 2007
DOI: 10.1051/forest:2006107

229

Original article

Climatic significance of tree-ring width and intra-annual density fluctuations in *Pinus pinea* from a dry Mediterranean area in Portugal

Filipe CAMPELO^{a,*}, Cristina NABAIS^a, Helena FREITAS^a, Emilia GUTIÉRREZ^b

Artim de Freitas, 3001-455 Coimbra, Portugal
Iona, Av. Diagonal, 645, 08028 Barcelona, Spain

Trees
DOI 10.1007/s00468-008-0273-0

ORIGINAL PAPER

Age-dependent responses of tree-ring growth and intra-annual density fluctuations of *Pinus pinaster* to Mediterranean climate

Joana Vieira · Filipe Campelo · Cristina Nabais

DOI 10.1007/s00382-007-0349-3

Mediterranean drought fluctuation during the last 500 years based on tree-ring data

A. Nicault · S. Alleaume · S. Brewer · M. Carrer · P. Nola · J. Guiot

New Phytol. (1994), 126, 355–367

Deciduous *Quercus* in the Mediterranean region: tree-ring/climate relationships

BY L. TESSIER¹, P. NOLA² AND F. SERRE-BACHET¹

¹ Institut Méditerranéen d'Ecologie et de Paléocécologie, URA CNRS D1152, Faculté des Sciences St-Jérôme, 13397 Marseille Cedex 13, France

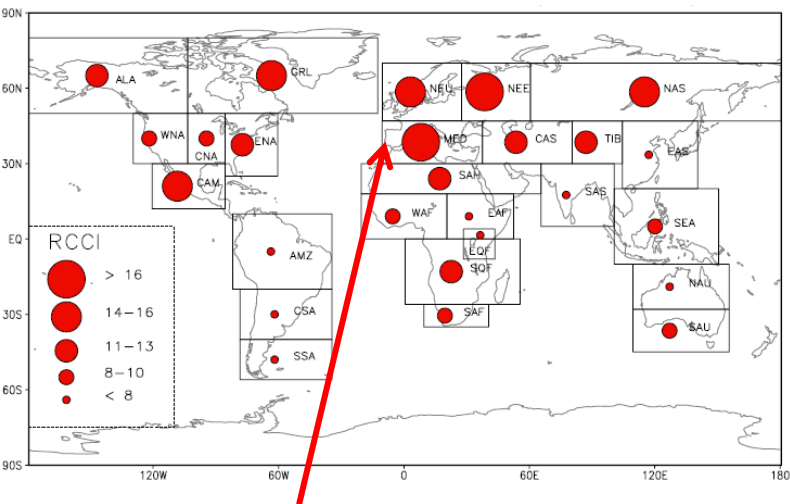
² Istituto di Botanica Orto Botanico, Univer. Roma, Italia

Dendrochronology of *Quercus ilex* L. and its potential use for climate reconstruction in the Mediterranean region

F. Campelo, C. Nabais, I. García-González, P. Cherubini, E. Gutiérrez, and H. Freitas

Climate change hot-spots

(Giorgi, 2006. Geophys. Res. Lett. 33)



Mediterranean hot-spot

Climate change in southern Europe

→ changes in land use

and water resources

→ impacts on the economy

+ risk of migration from

sub-Saharan Africa and the Arab world

(Scheffran and Battaglini, 2011. Reg. Environ. Change 11)

July-August
seasonal changes
in precipitation

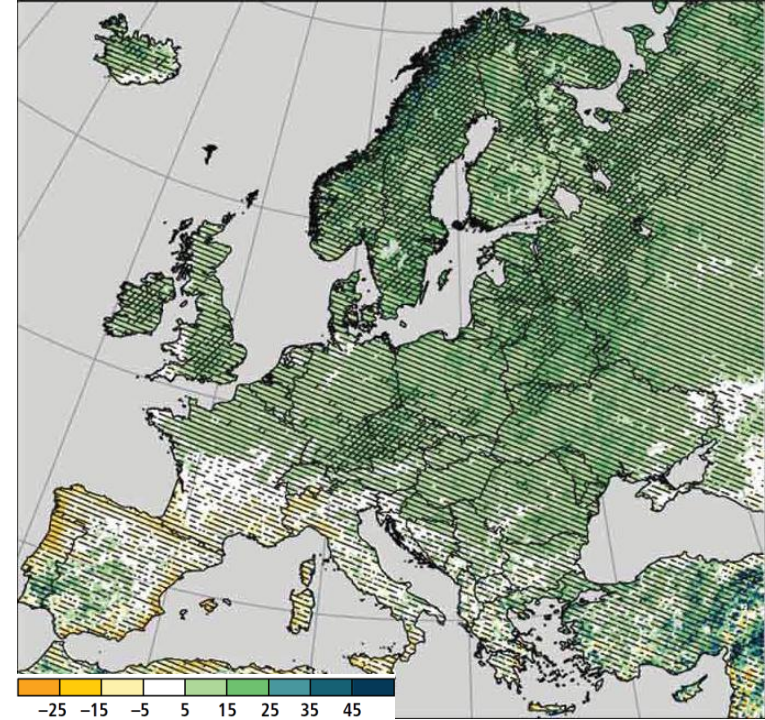
(%)

2071–2100

compared to

1971–2000

(IPCC, 2014)



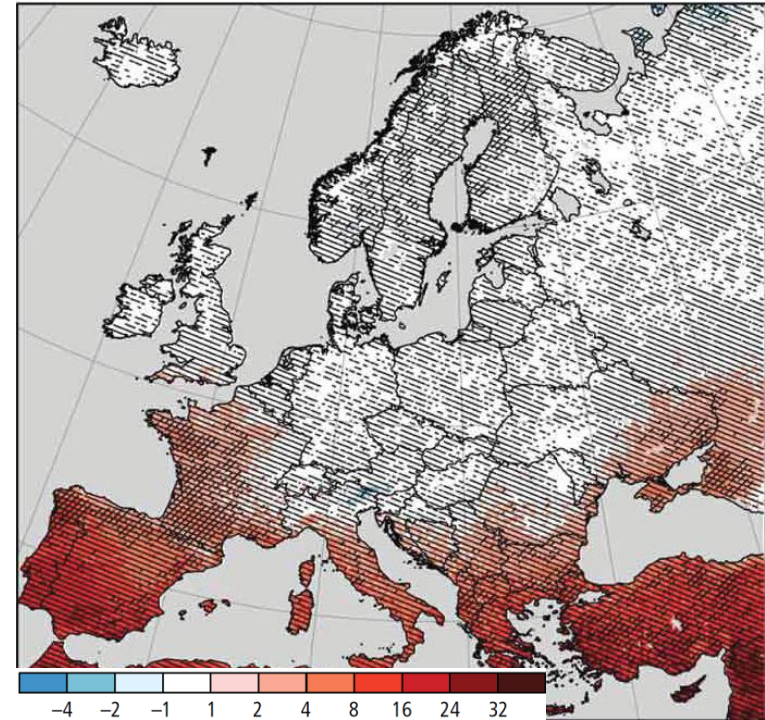
Changes in the
length of dry
spells (days)

2071–2100

compared to

1971–2000

(IPCC, 2014)



Actual climate change impacts on Iberian forests

- Changes in species distribution and phenology
(Benito-Garzón et al., 2008, Appl. Veg. Sci. 11(2); Peñuelas et al. 2002, Glob. Change Biol. 8(6))
- Reduction of non-wood forest products
(Büntgen et al. 2015, Fungal Ecol. 16)
- Increased disturbances (e.g. pests, fires) and stand decline processes (defoliation)
(Pausas, 2004, Climatic Change 63(3); Carnicer et al. 2011, P. Natl. Acad. Sci. USA 108(4))

Tree-ring studies and climate change in Iberian forests

- Warming-induced growth reduction in southern/lower sites
(Martín-Benito et al. 2010, Ann. For. Sci. 67(4); Gea-Izquierdo et al., 2014, Forest Ecol. Manag. 2014)
- Warming/CO₂-induced growth enhancement in northern/higher sites
(Martín-Benito et al. 2010, Ann. For. Sci. 67(4); Camarero et al., 2015, Glob. Change Biol. 21(2))
- Treeline dynamics
(Batllori and Gutiérrez, 2008, J. Ecol. 96(6); Jump et al., 2007, Ecoscience 14(4))
- Increase of tree mortality (Natalini et al., 2016, Dendrochronologia 38)





Pinus pinea L.



Bark

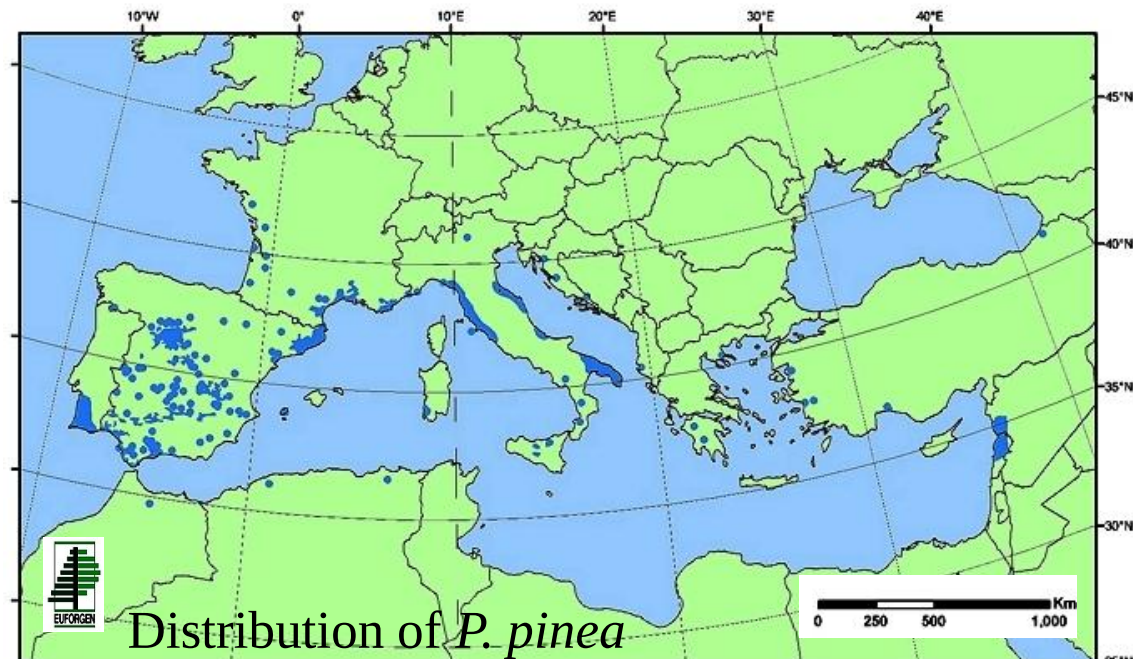


Tree rings

“Umbrella pine”,
“Italian stone pine”

Mediterranean conifer
(fam. *Pinaceae*)

- Timber, biomass
- Non-wood forest products
- Environmental services
- Social/cultural values



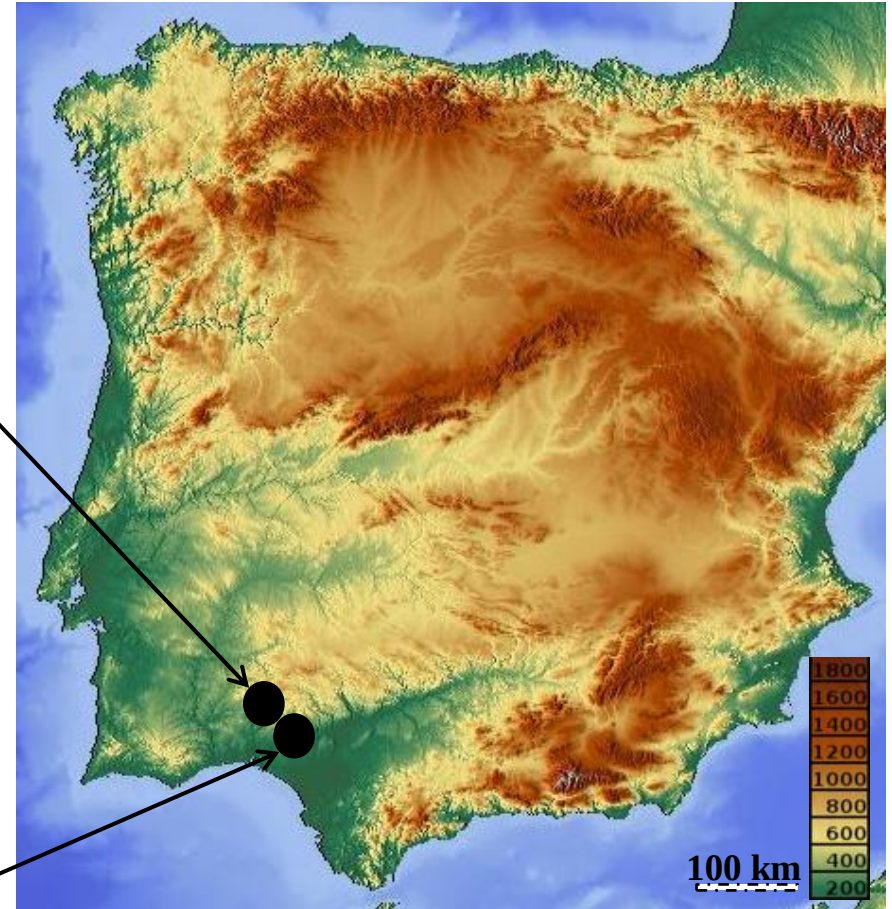
Objectives

Contributing to the study of growth dynamics of Mediterranean forests with the use of tree rings

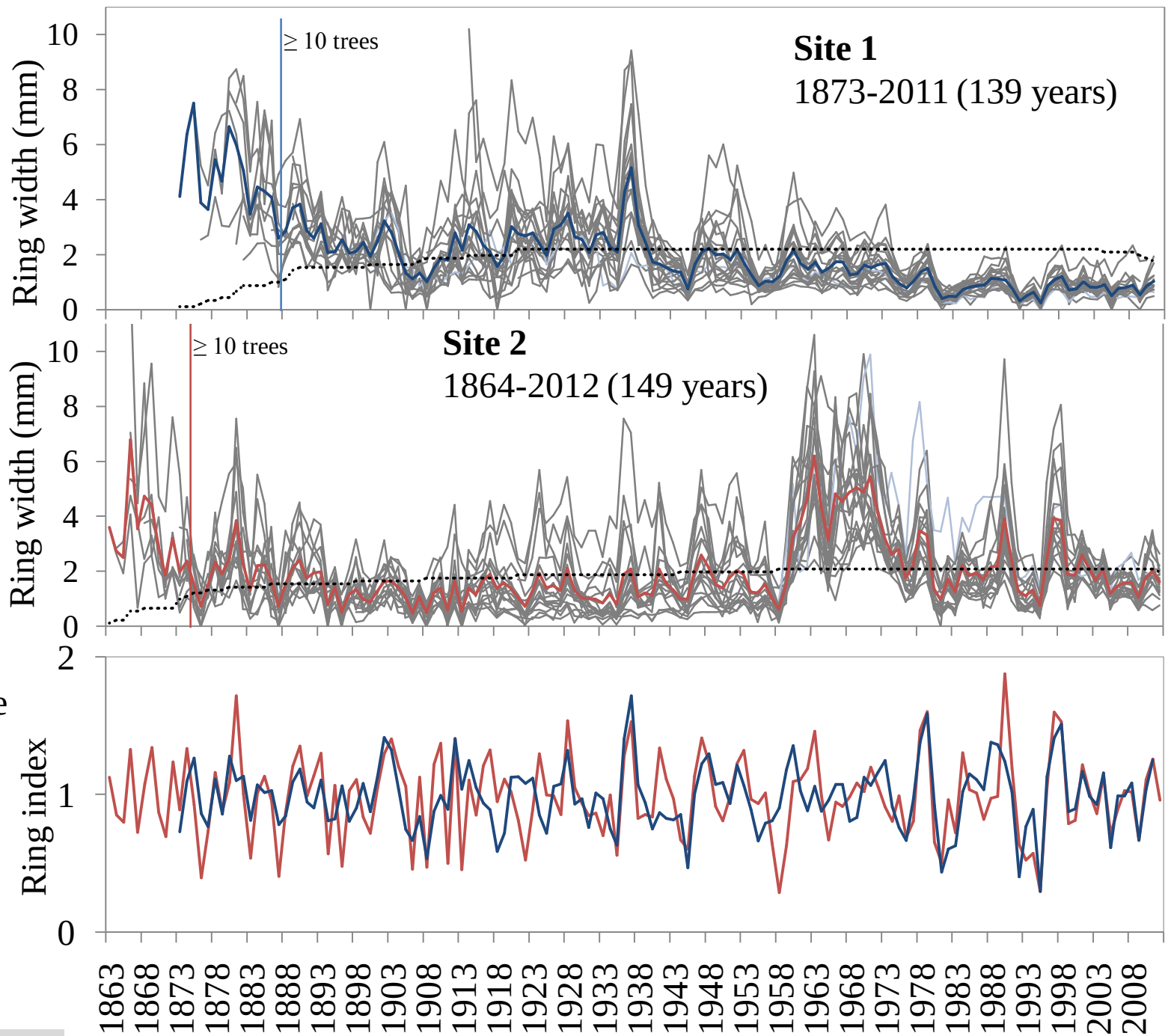
Improving the knowledge about adaptability and vulnerability of *Pinus pinea* under warmer and drier climate



Study sites 1 and 2

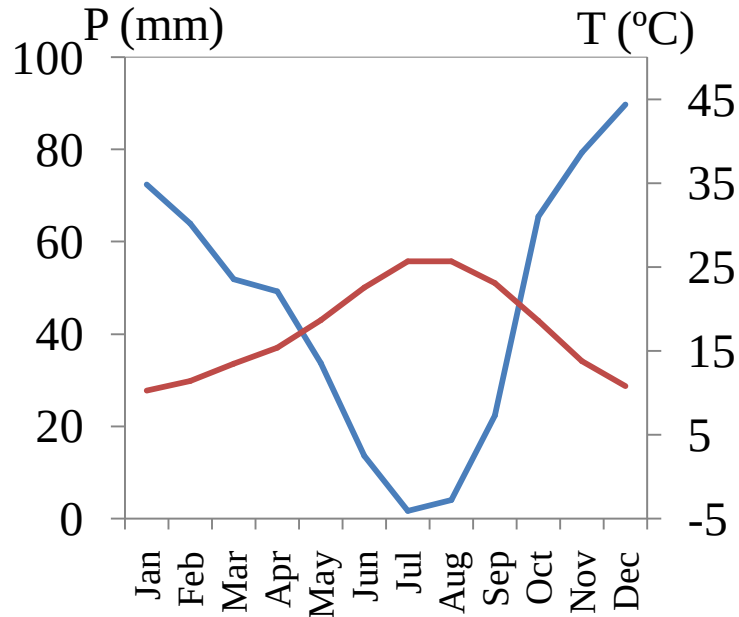
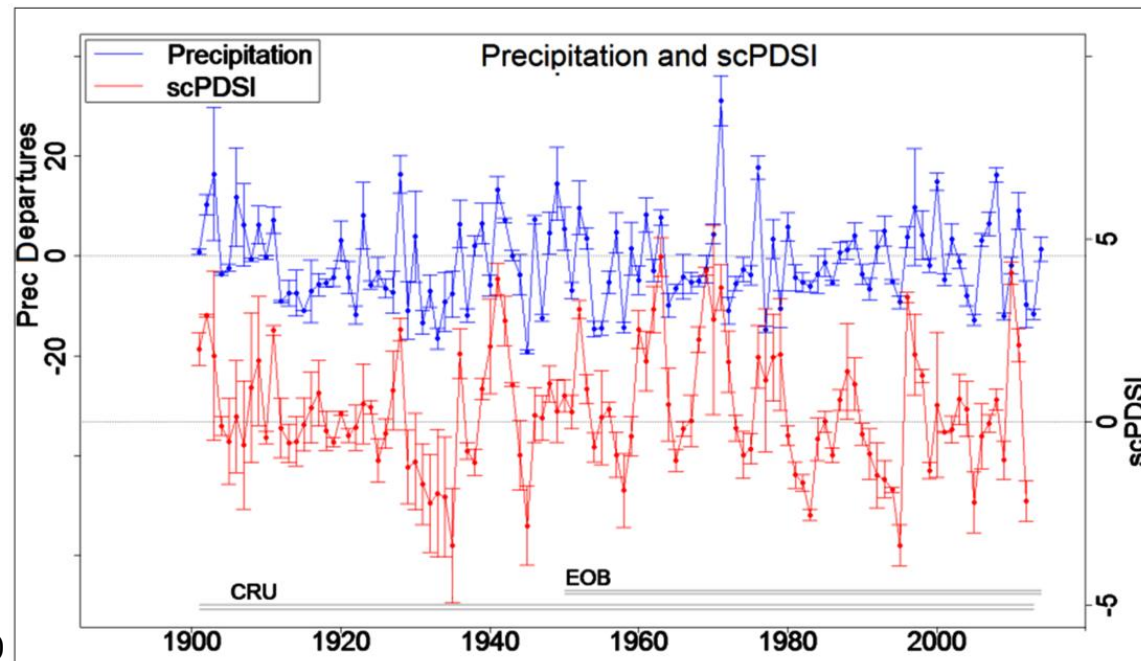
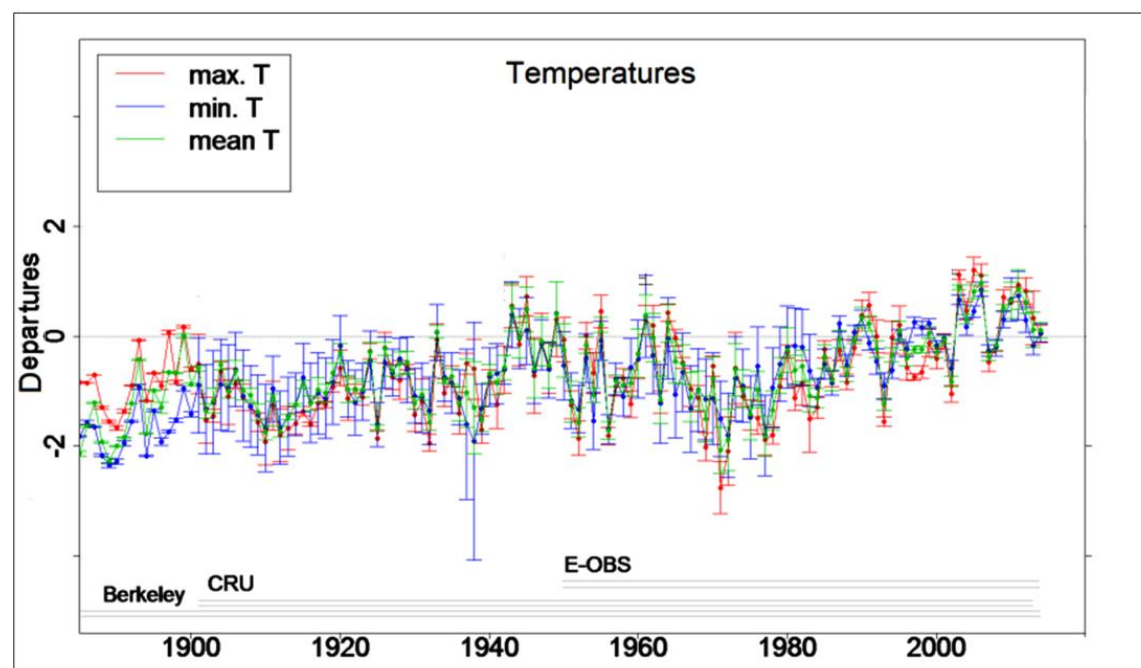


Monospecific *P. pinea* stands
Even-aged
Density ≈ 150 trees/ha
Elevation ≈ 100 m a.s.l.



Climate data

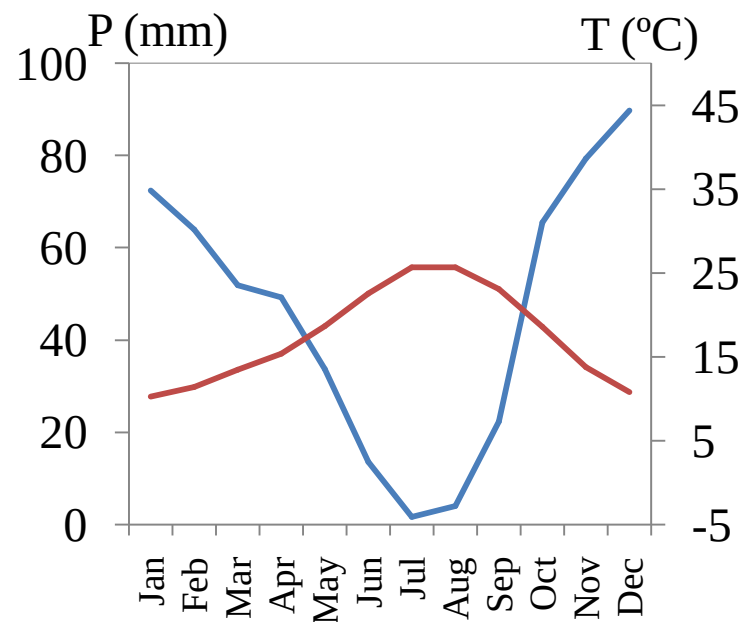
Gridded datasets	Climate parameters
CRU TS3.23	P (mm), T (°C)
CRU 3.21	scPDSI
E-OBS v11.0	P (mm), T (°C)
Berkeley Earth	T (°C)



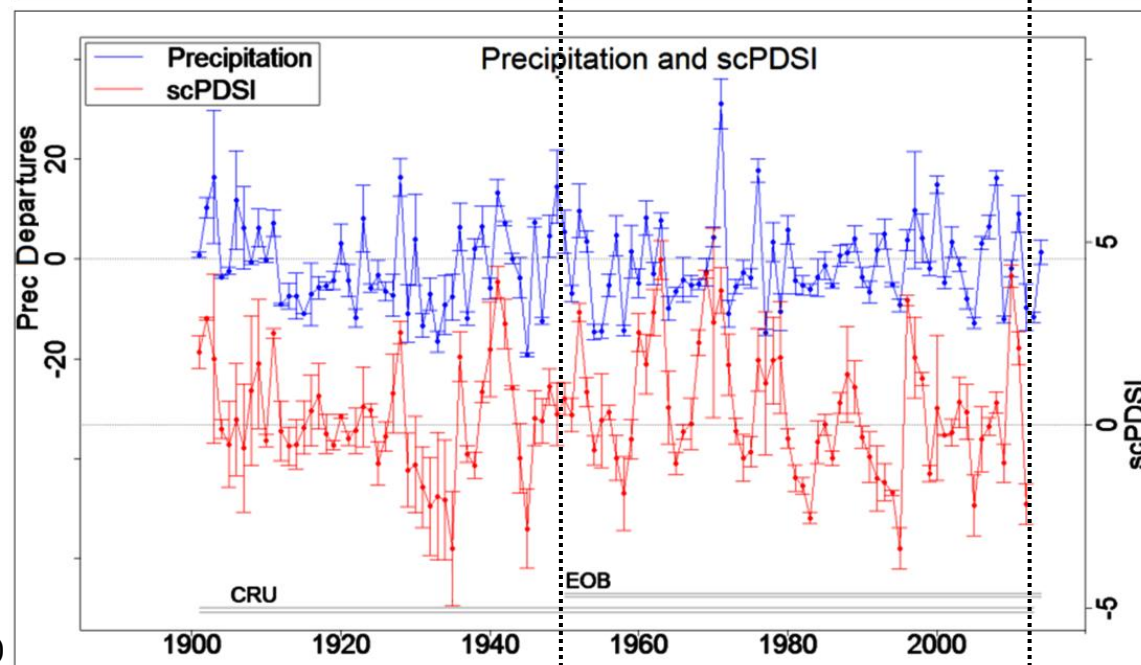
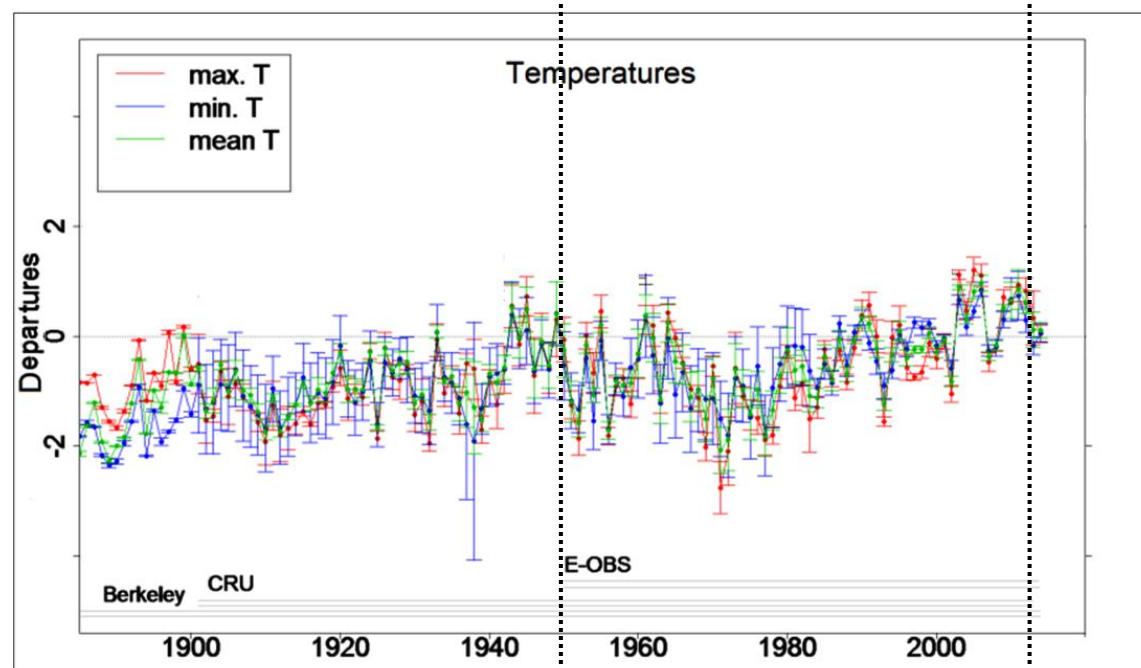
(Natalini et al., in preparation)

Climate data

Gridded datasets	Climate parameters
CRU TS3.23	P (mm), T (°C)
CRU 3.21	scPDSI
E-OBS v11.0	P (mm), T (°C)
Berkeley Earth	T (°C)



(Natalini et al., in preparation)

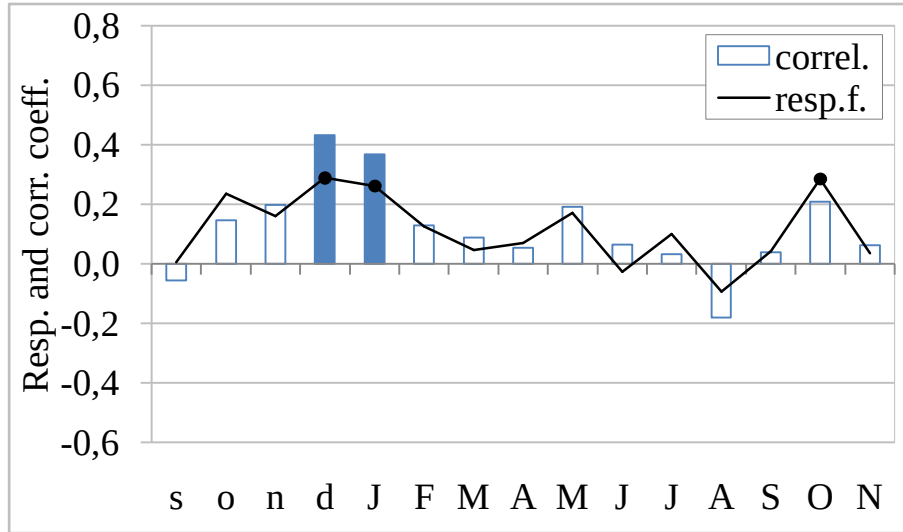


Common period

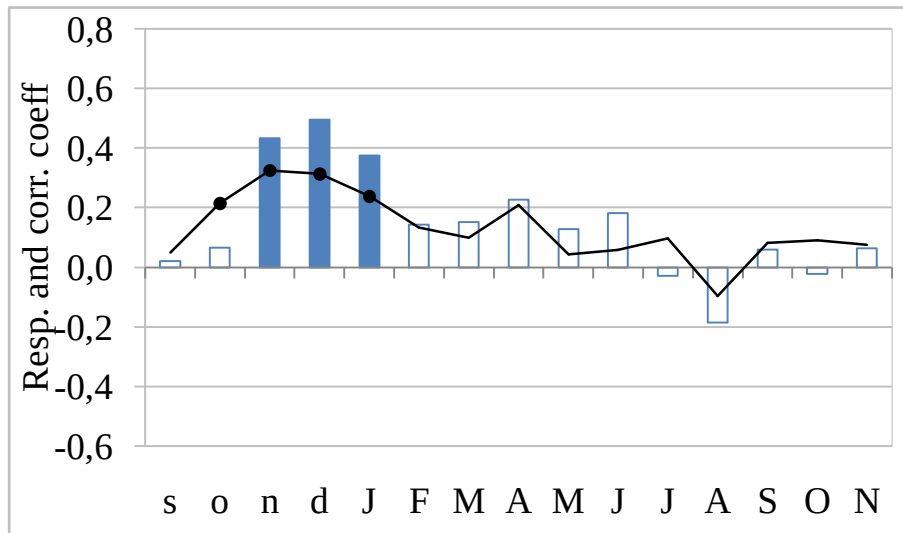
Growth-climate relationships

Over the common period 1950-2009
precipitation

Site 1



Site 2

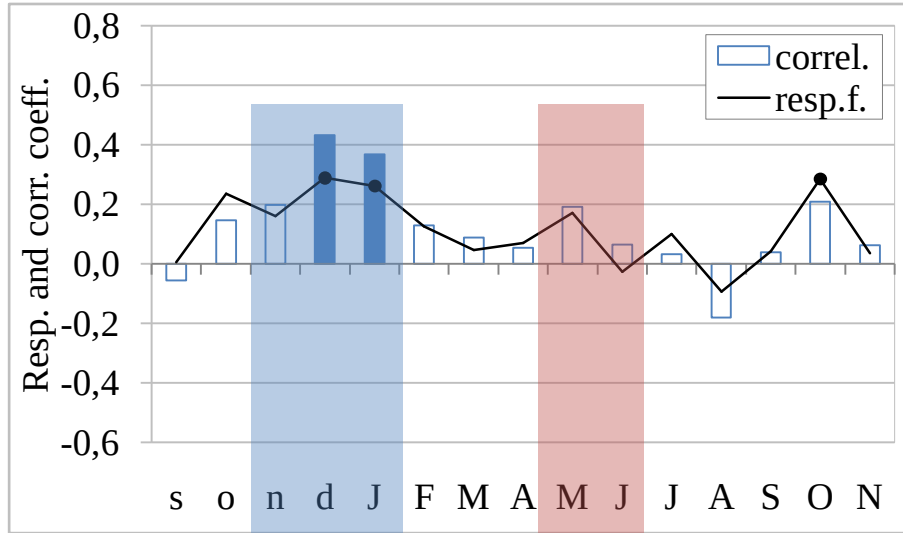


(Natalini et al., in preparation)

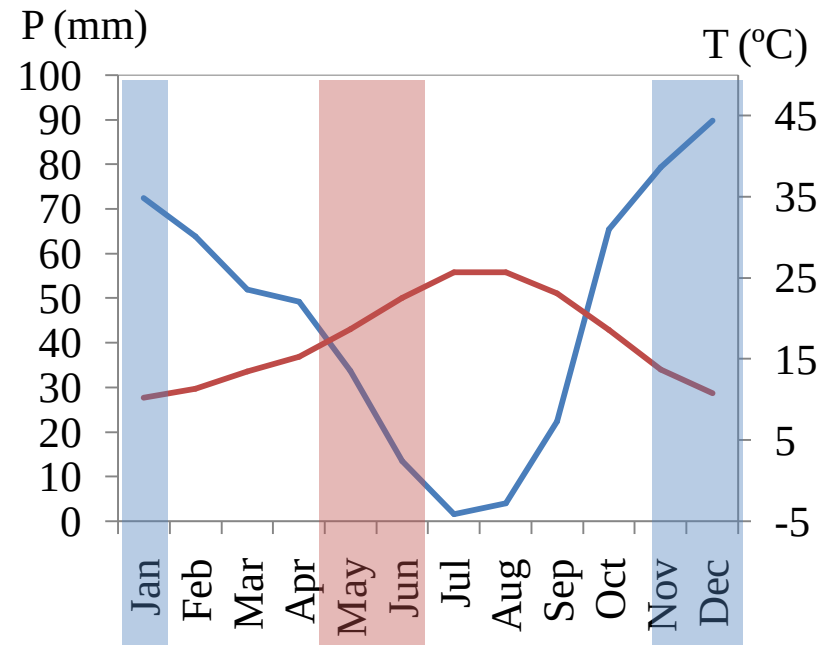
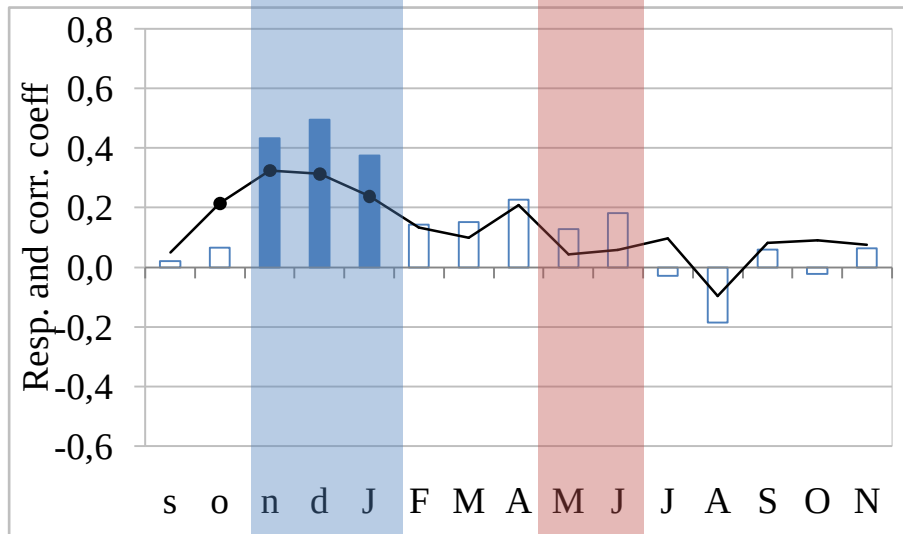
Growth-climate relationships

Over the common period 1950-2009
precipitation

Site 1



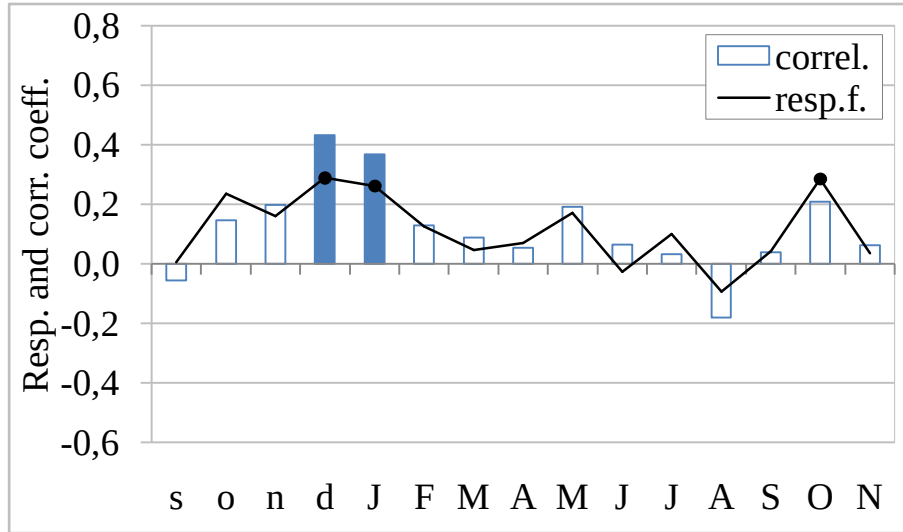
Site 2



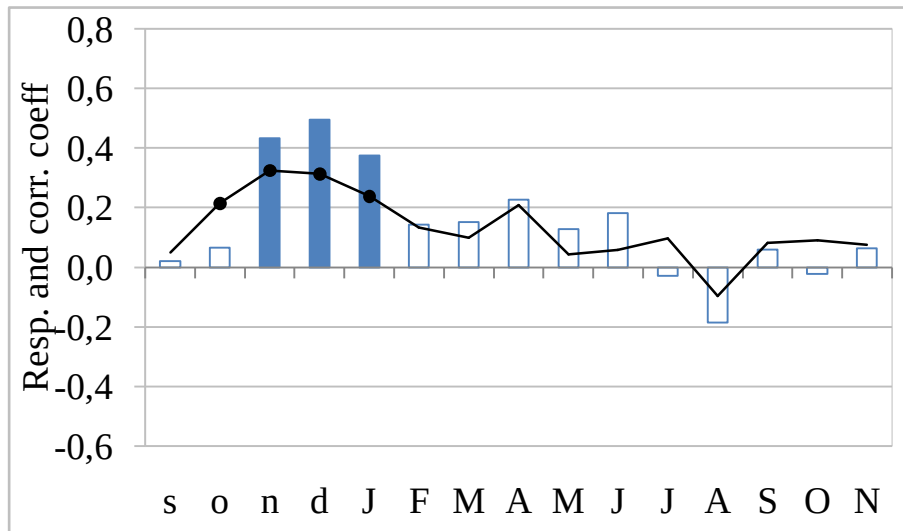
Growth-climate relationships

Over the common period 1950-2009
precipitation

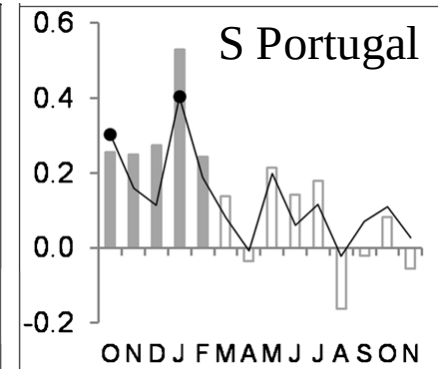
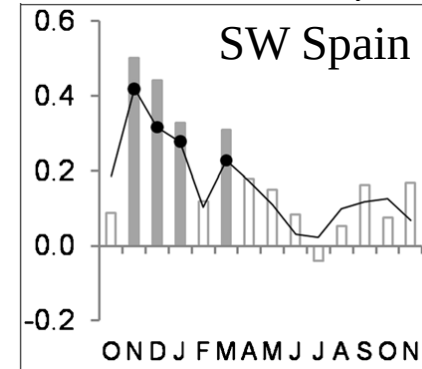
Site 1



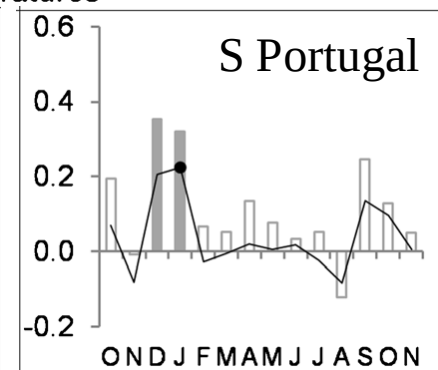
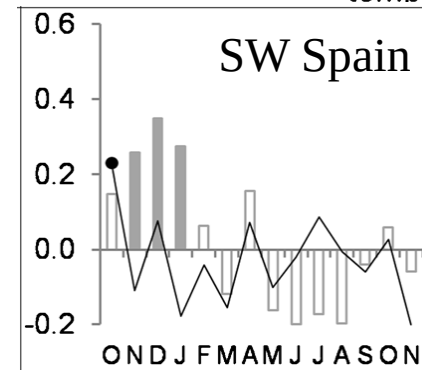
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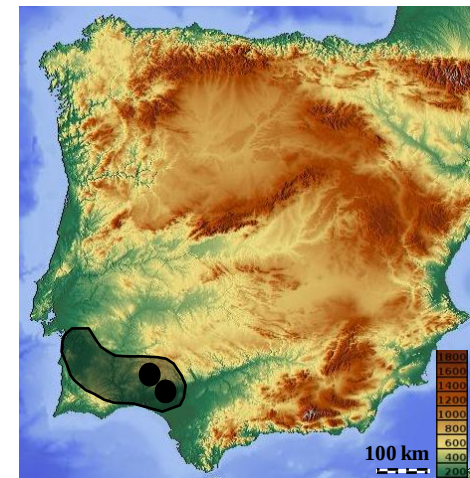
precipitation



temperatures

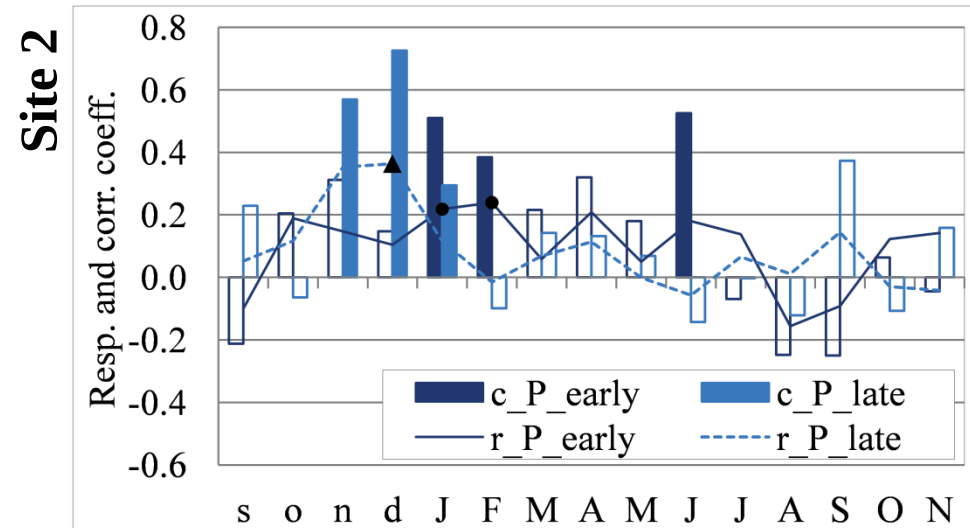
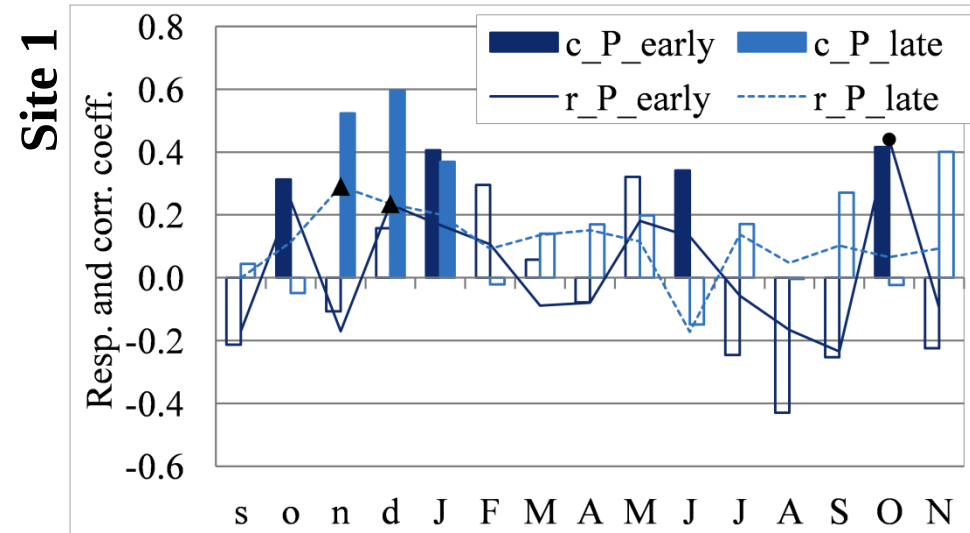


(Natalini et al., 2015. Ann. For. Sci. 72)



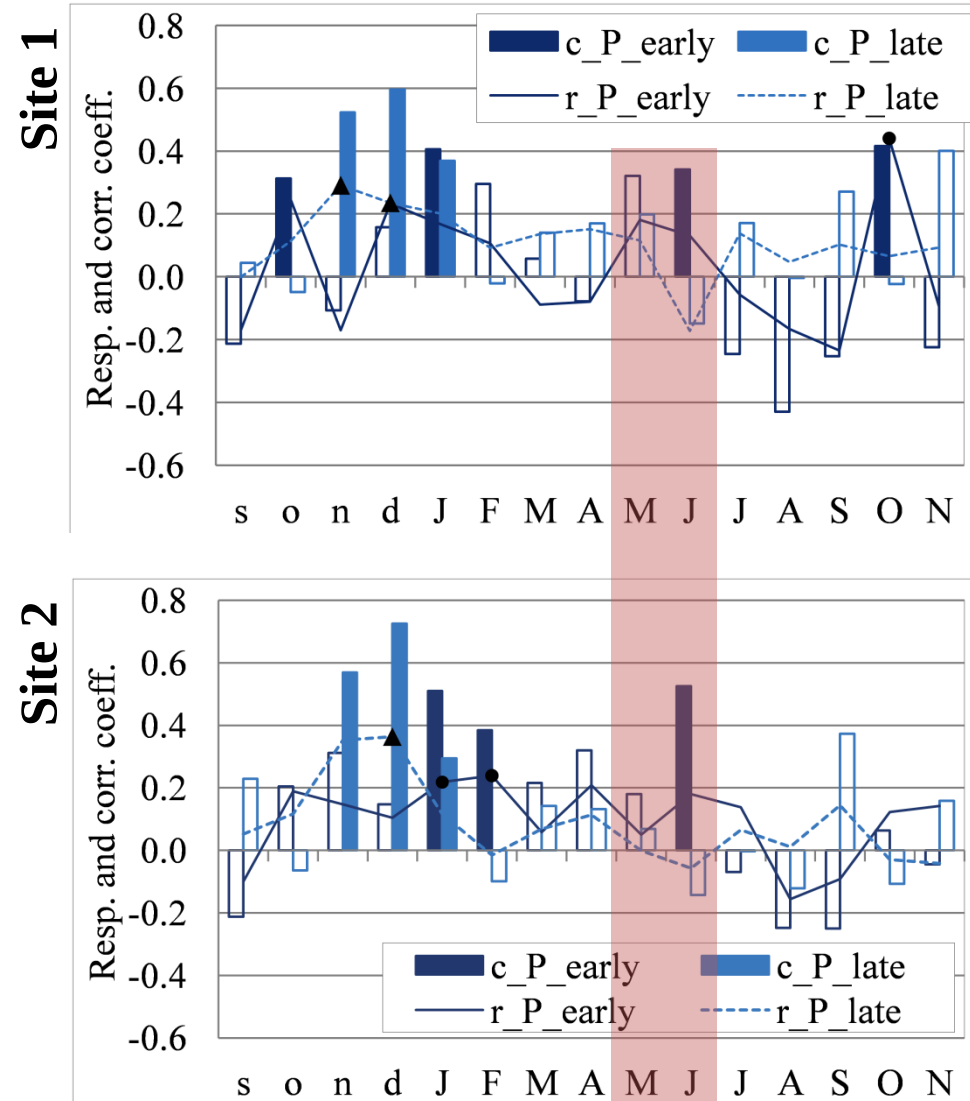
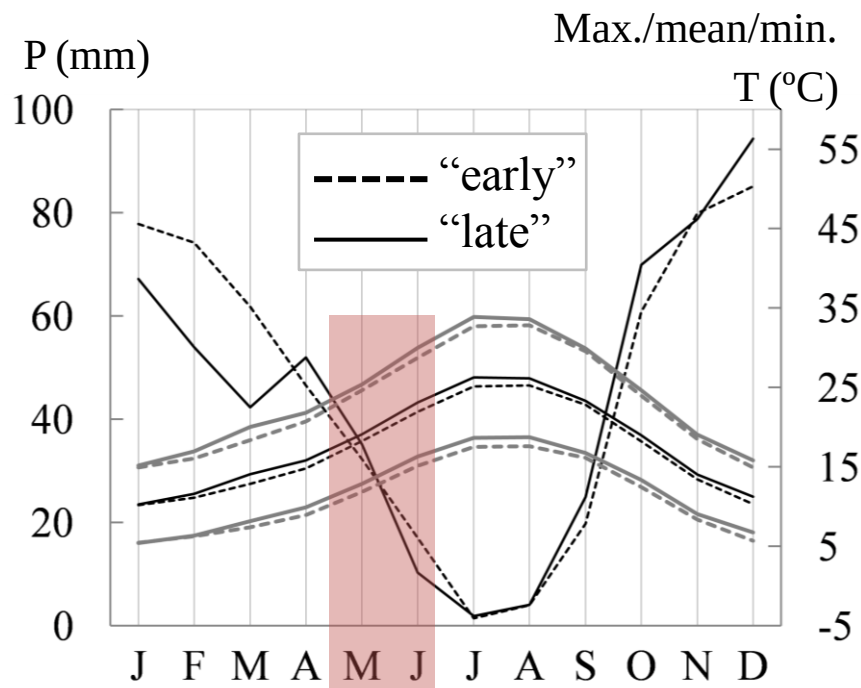
Growth-climate relationships

Over successive 30-year time windows
(1950-1979, “**early**”; 1980-2009, “**late**”)

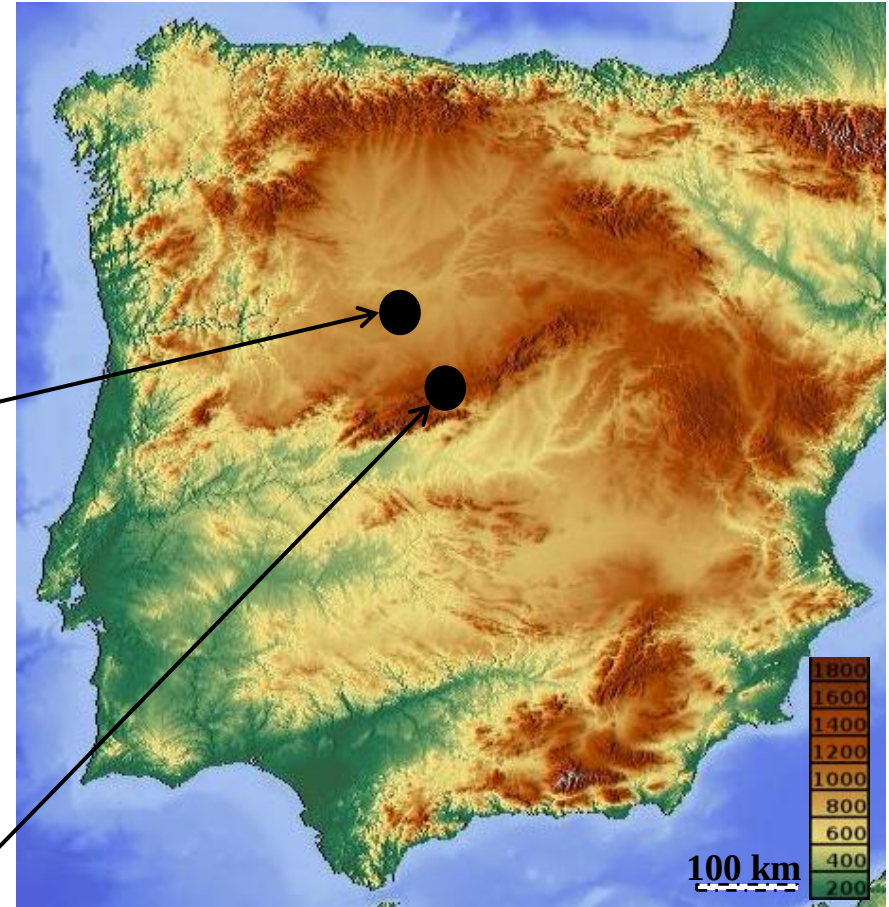


Growth-climate relationships

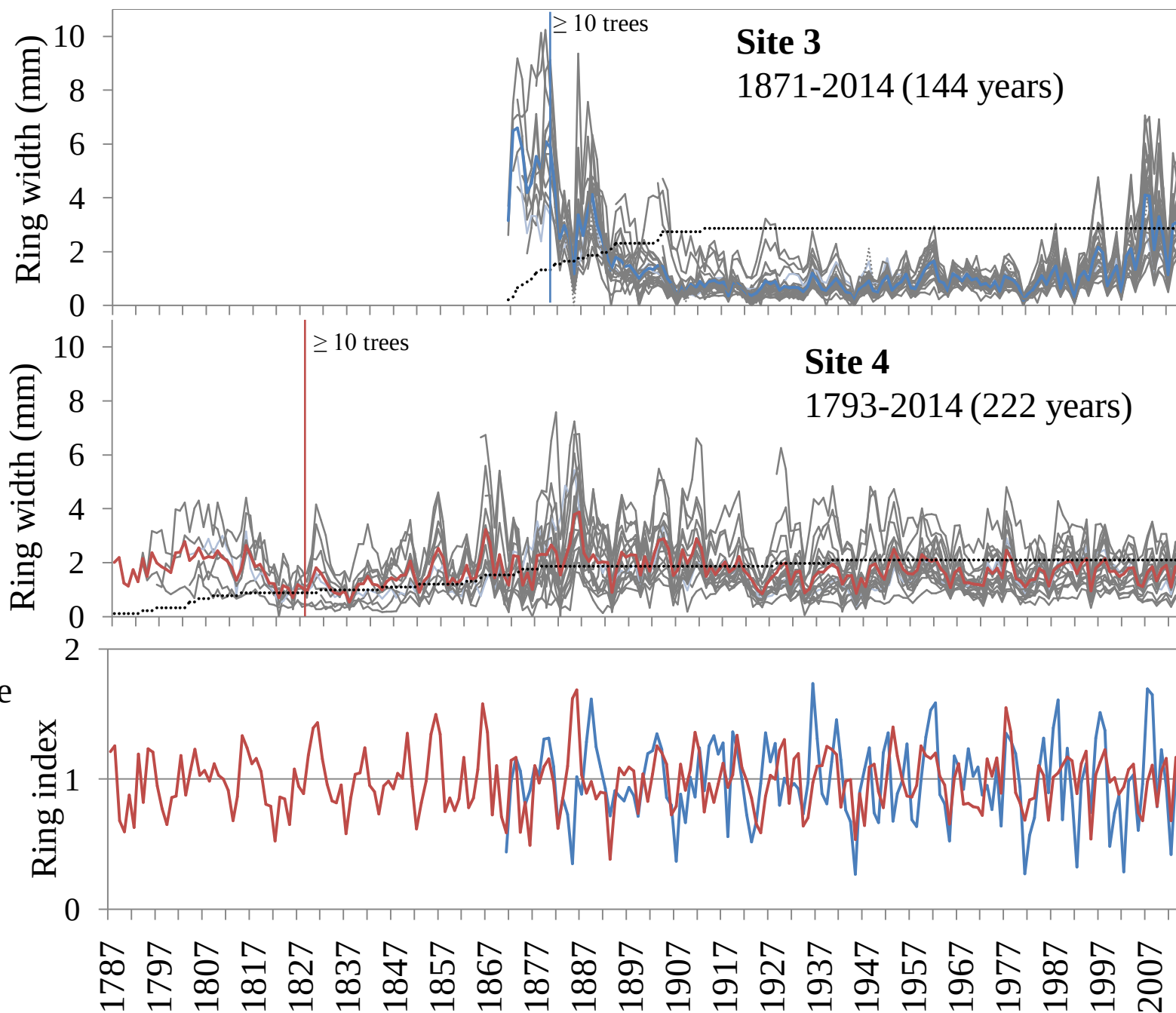
Over successive 30-year time windows
(1950-1979, “early”; 1980-2009, “late”)



Study sites 3 and 4



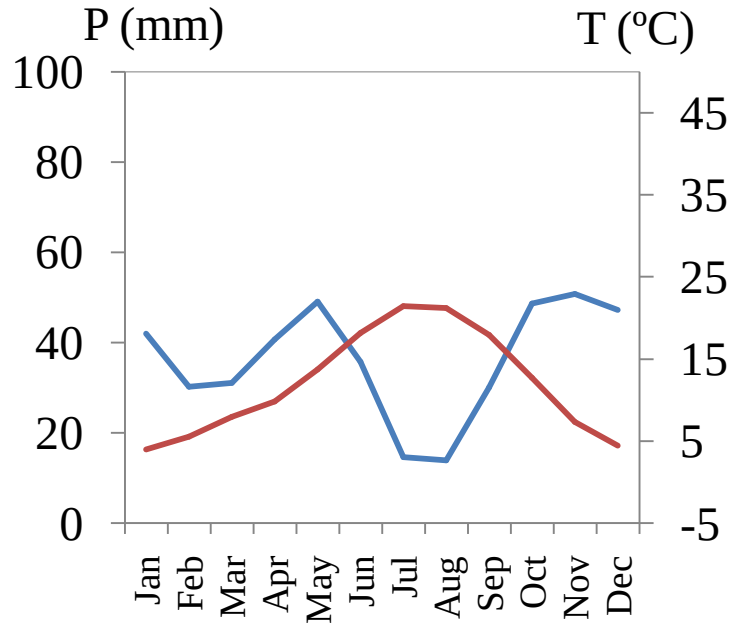
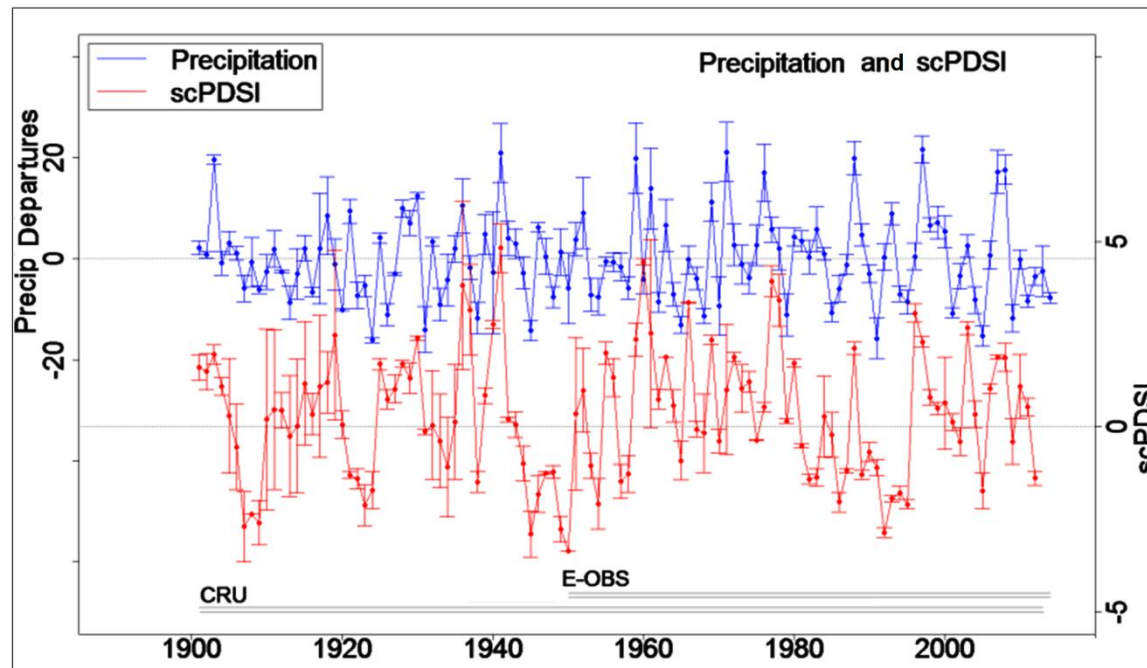
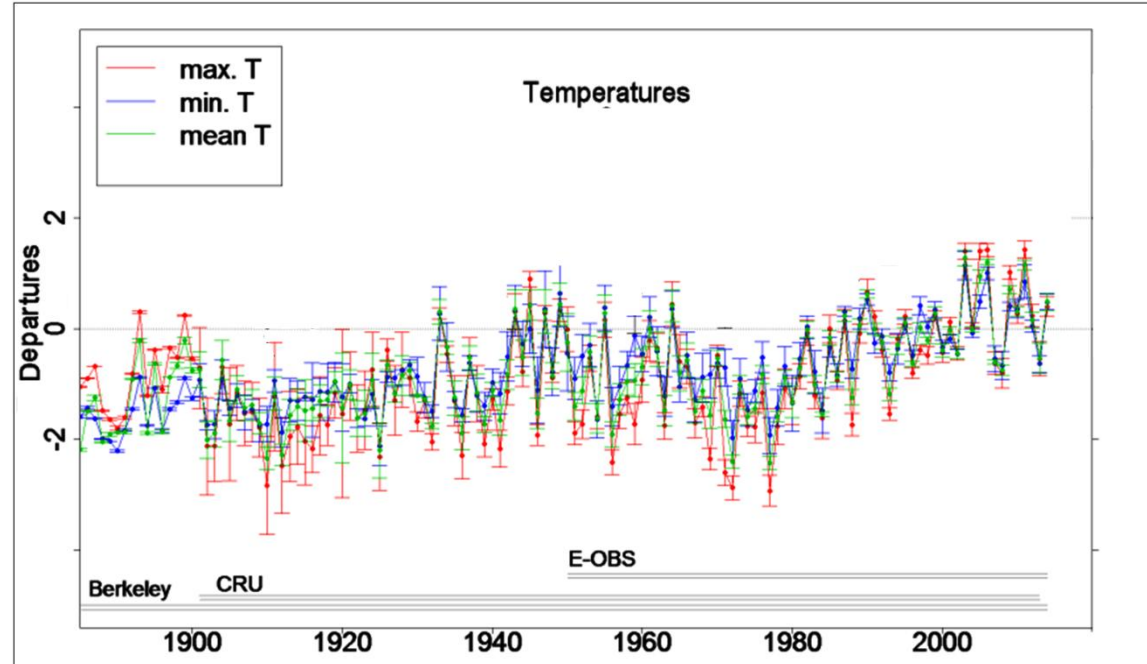
Monospecific *P. pinea* stands
Even-aged
Density 100-150 trees/ha
Elevation 800-900 m a.s.l.



Detrending:
30-year spline
(Natalini et al.;
TRACE Vol.
under review)

Climate data

Gridded datasets	Climate parameters
CRU TS3.23	P (mm), T (°C)
CRU 3.21	scPDSI
E-OBS v11.0	P (mm), T (°C)
Berkeley Earth	T (°C)

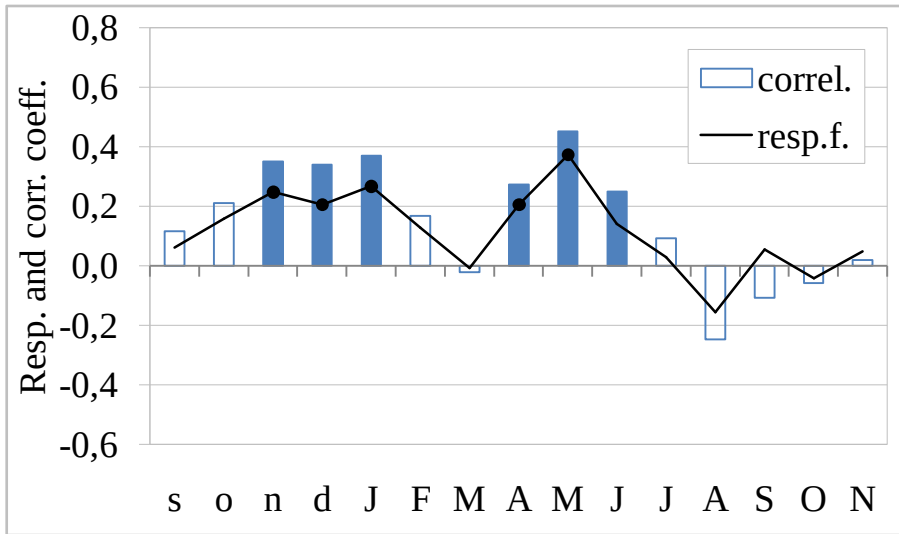


(Natalini et al., in preparation)

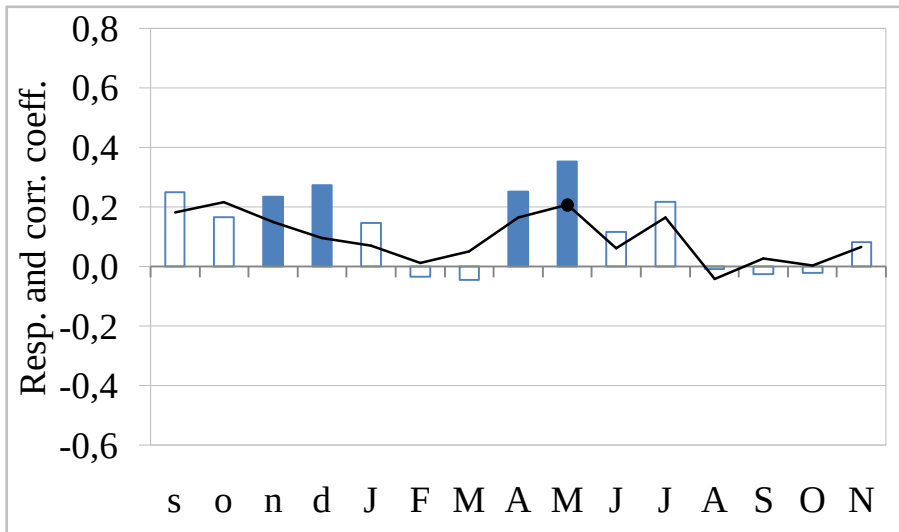
Growth-climate relationships

Over the common period 1950-2009
precipitation

Site 3



Site 4

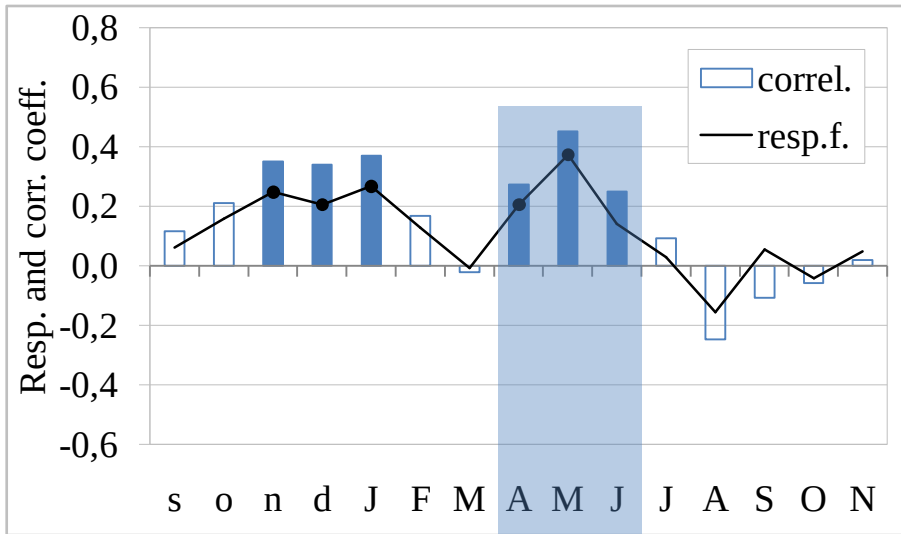


(Natalini et al., in preparation)

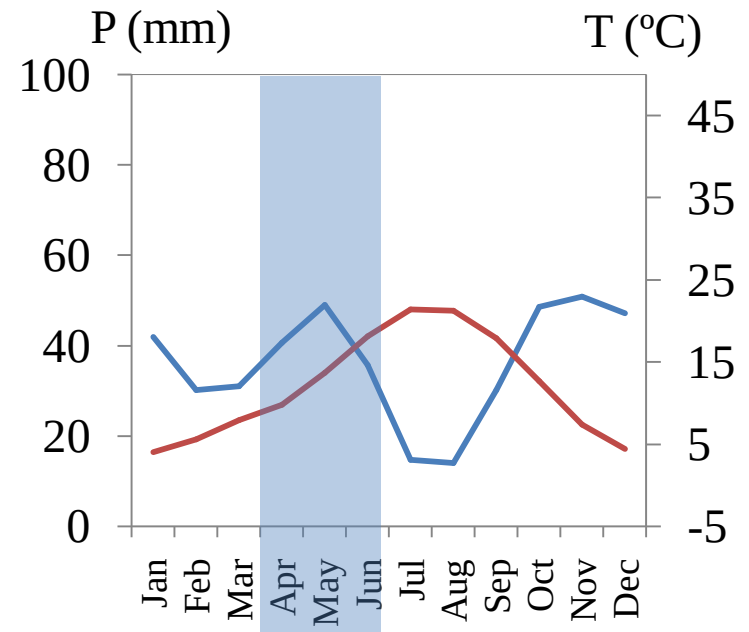
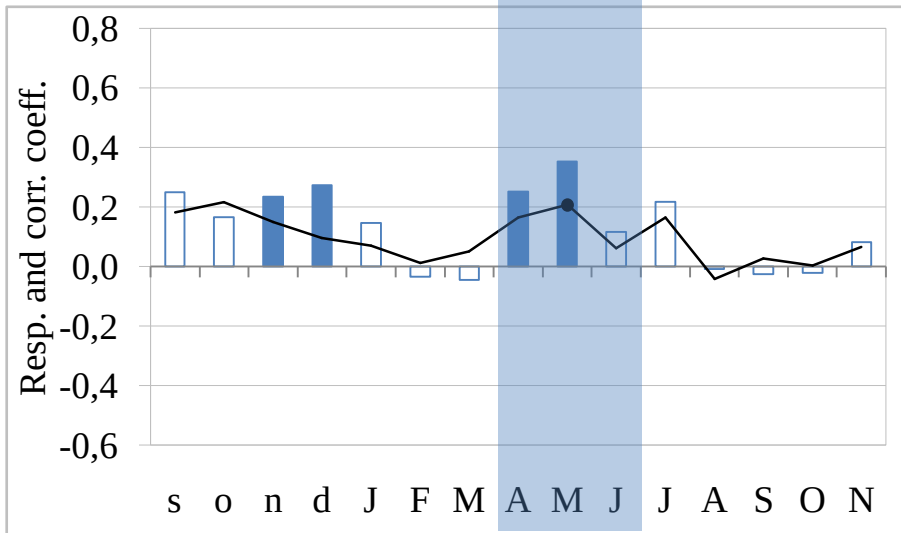
Growth-climate relationships

Over the common period 1950-2009
precipitation

Site 3



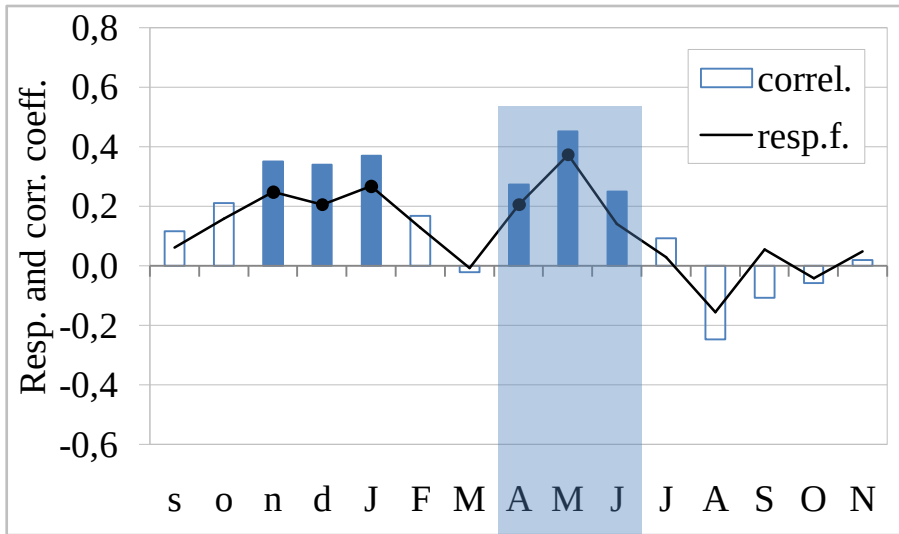
Site 4



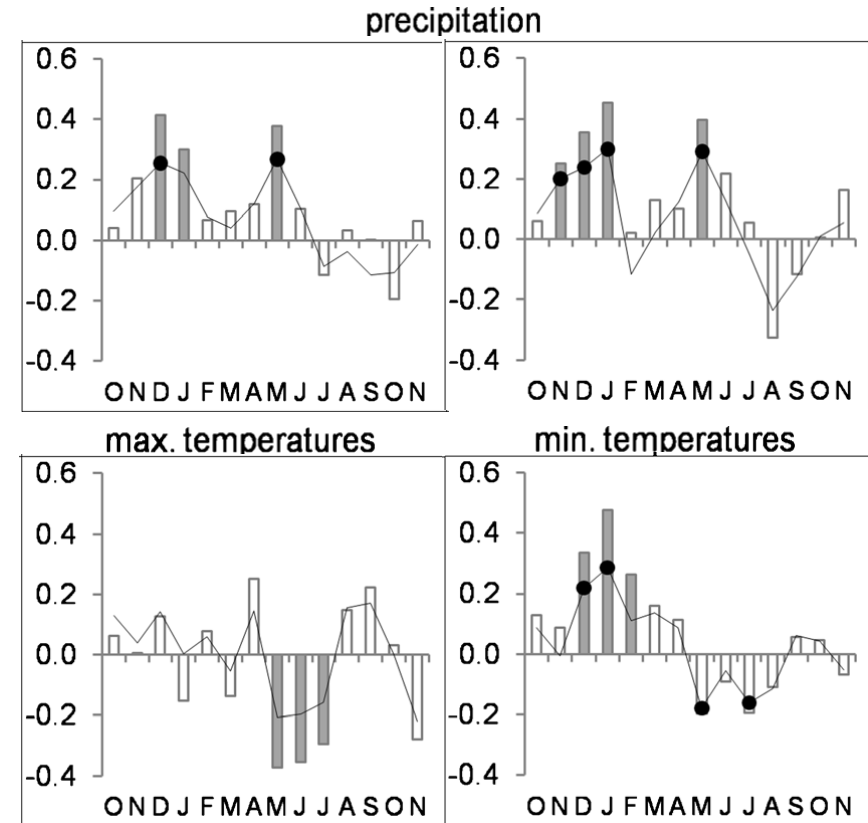
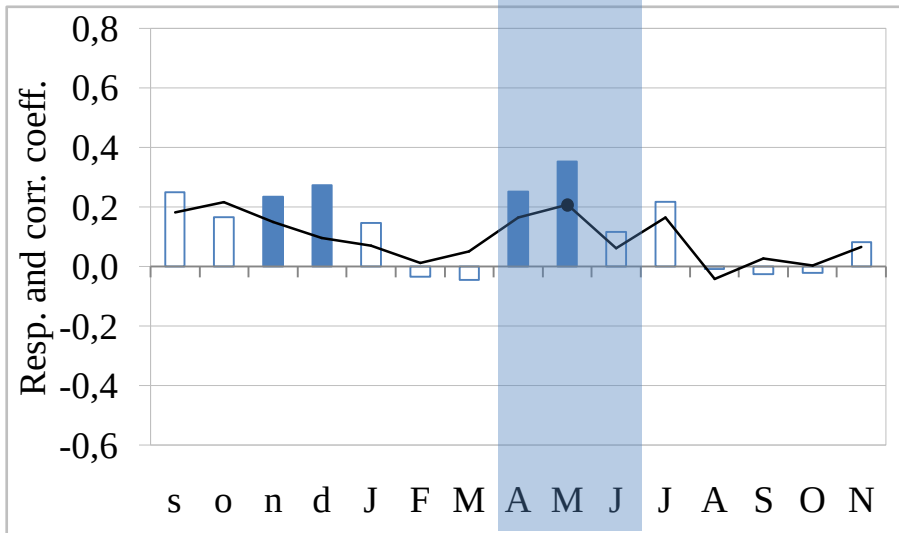
Growth-climate relationships

Over the common period 1950-2009
precipitation

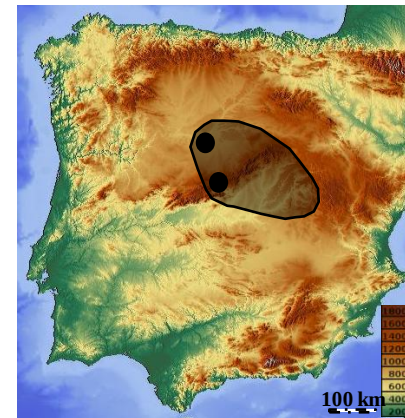
Site 3



Site 4

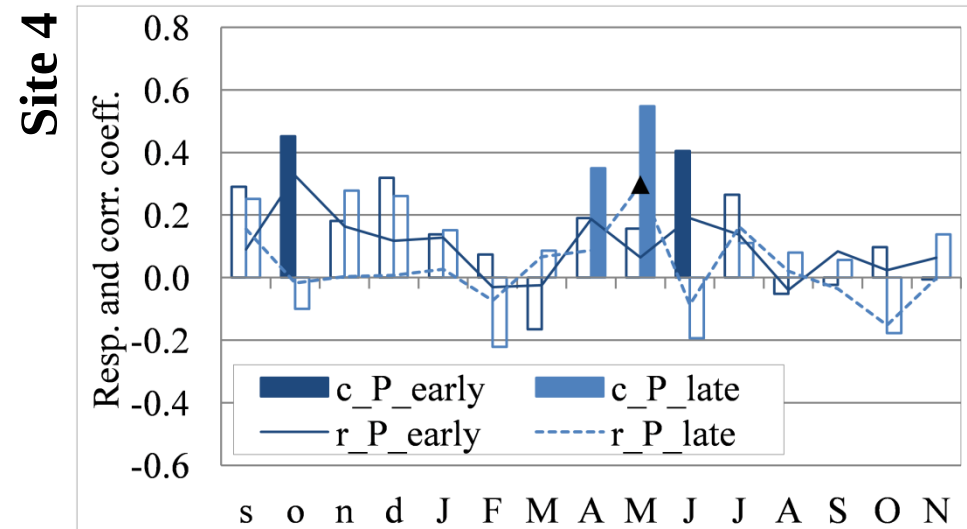
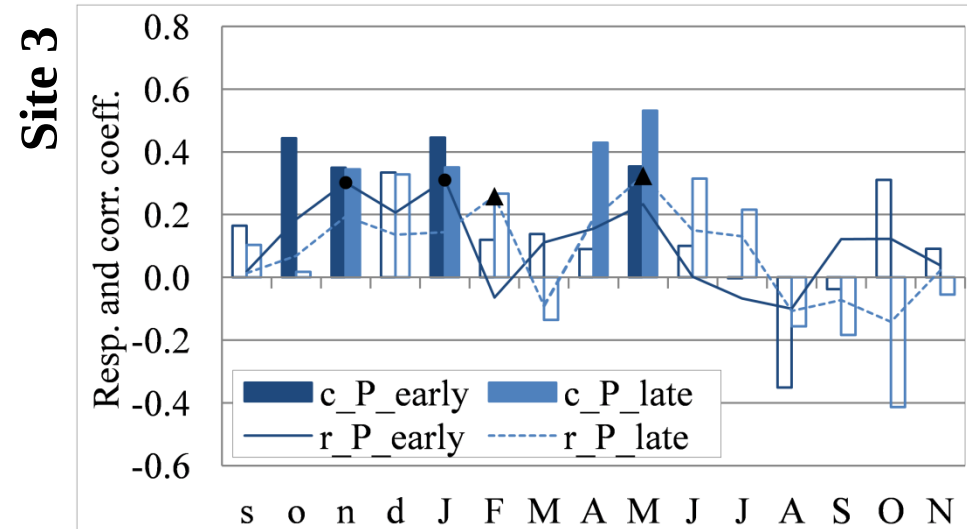


(Natalini et al., 2015. Ann. For. Sci. 72)



Growth-climate relationships

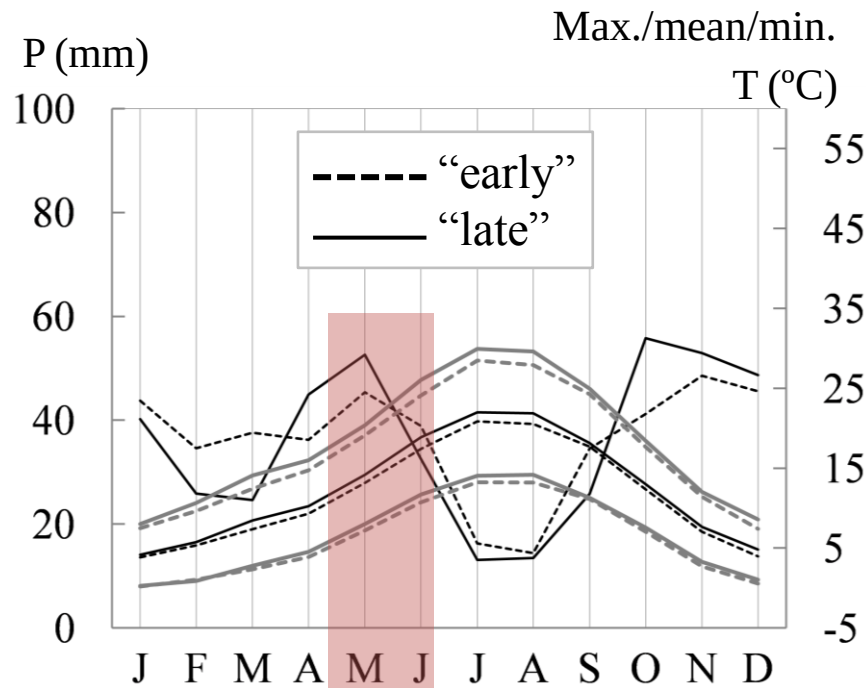
Over successive 30-year time windows
(1950-1979, “**early**”; 1980-2009, “**late**”)



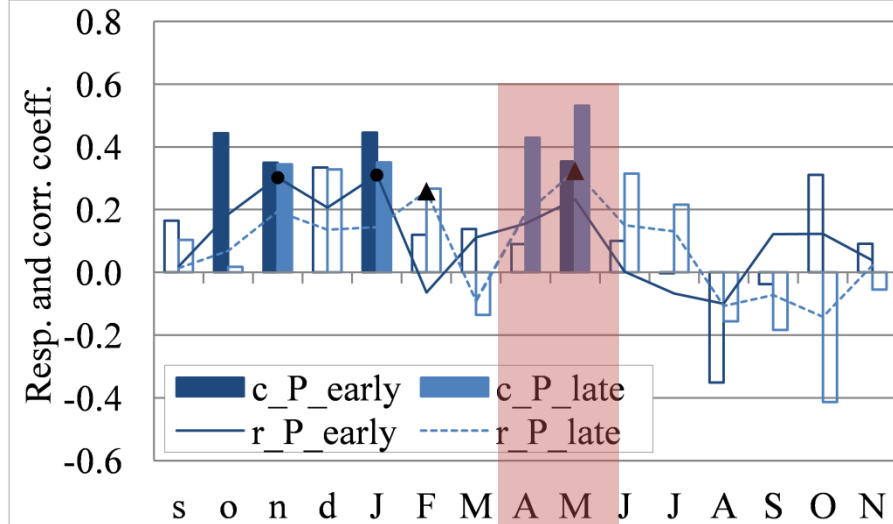
(Natalini et al., in preparation)

Growth-climate relationships

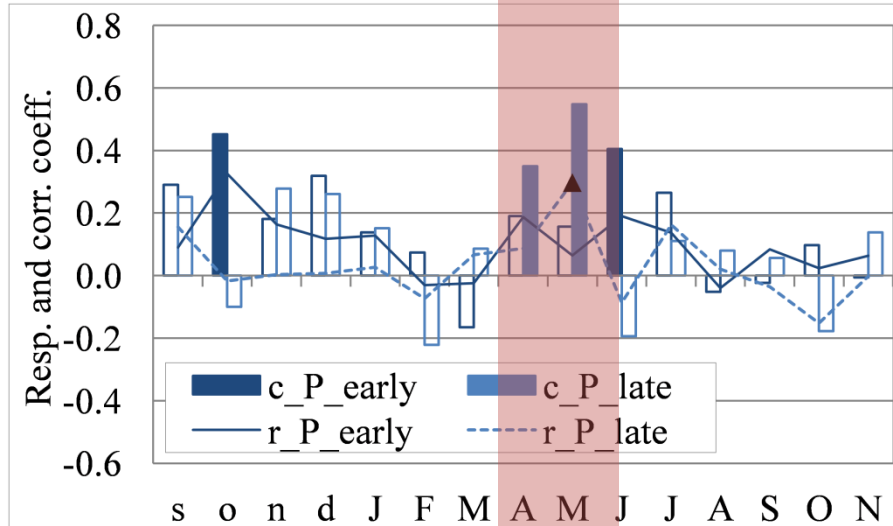
Over successive 30-year time windows
(1950-1979, “early”; 1980-2009, “late”)



Site 3



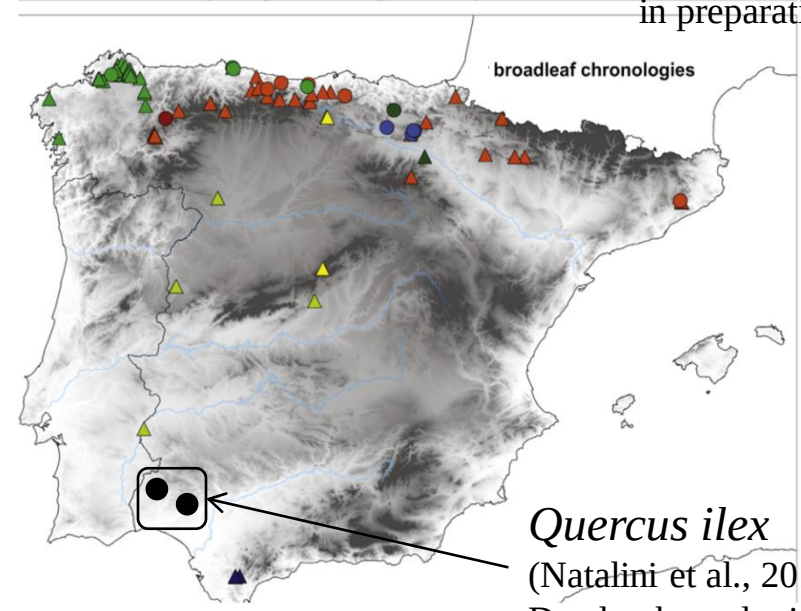
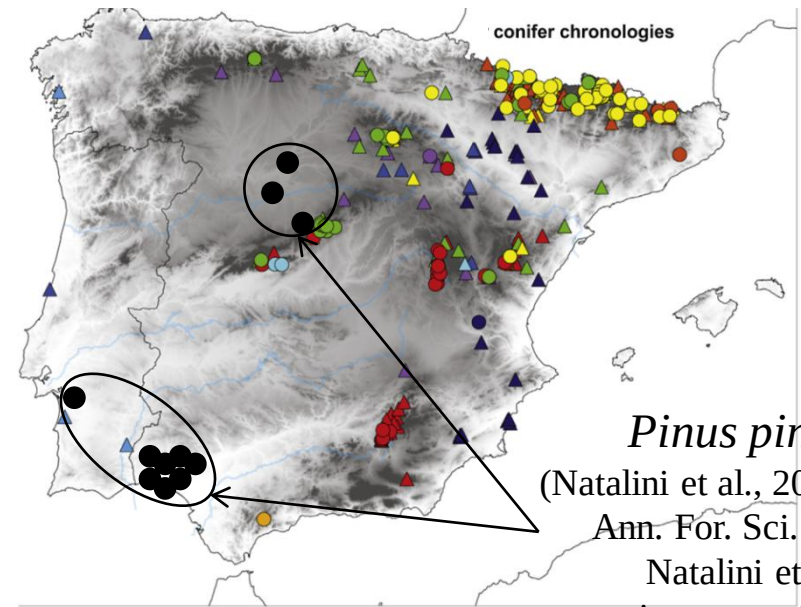
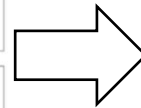
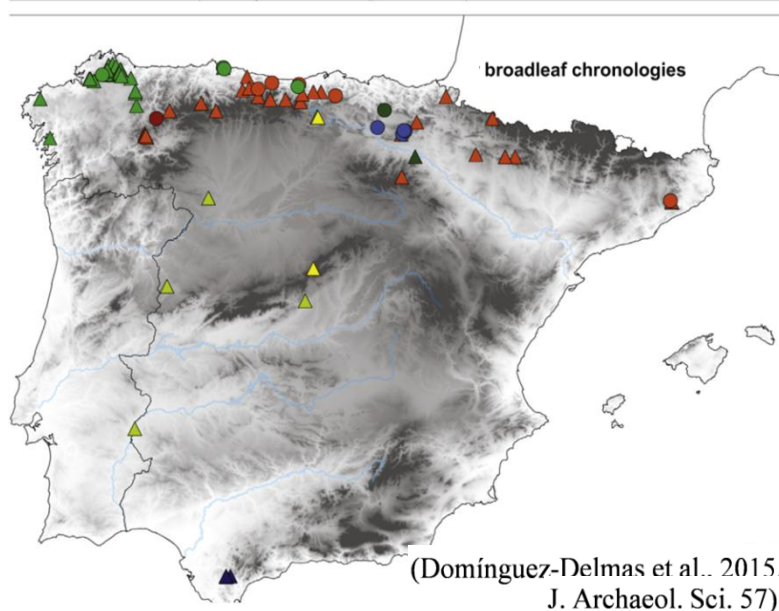
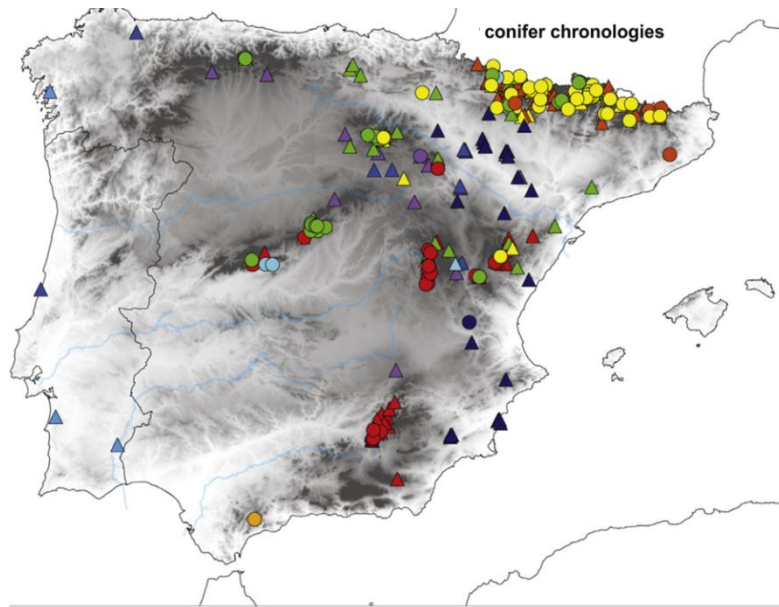
Site 4



(Natalini et al., in preparation)

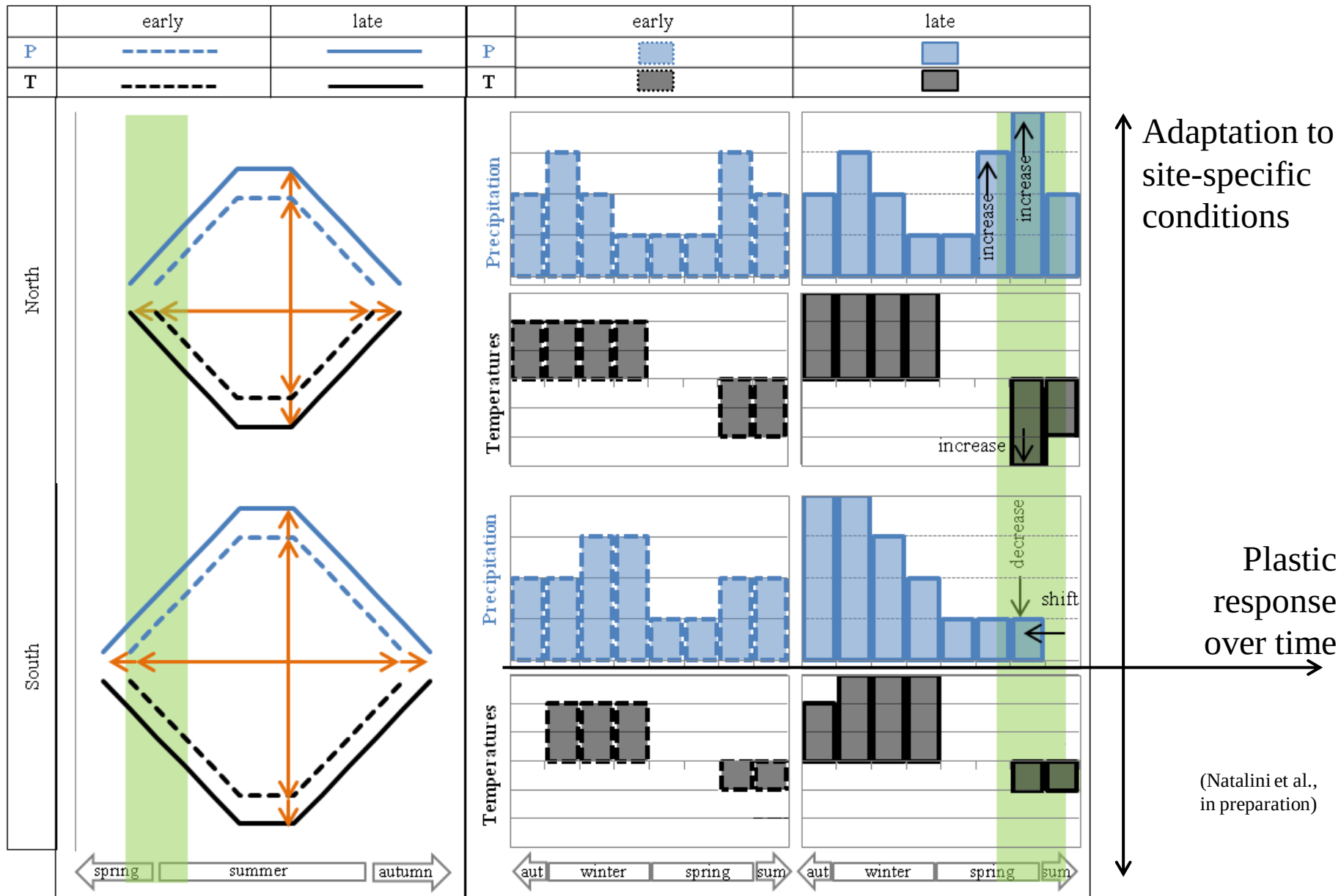
Conclusions

1) New chronologies for the Iberian Peninsula, including southern Mediterranean sites



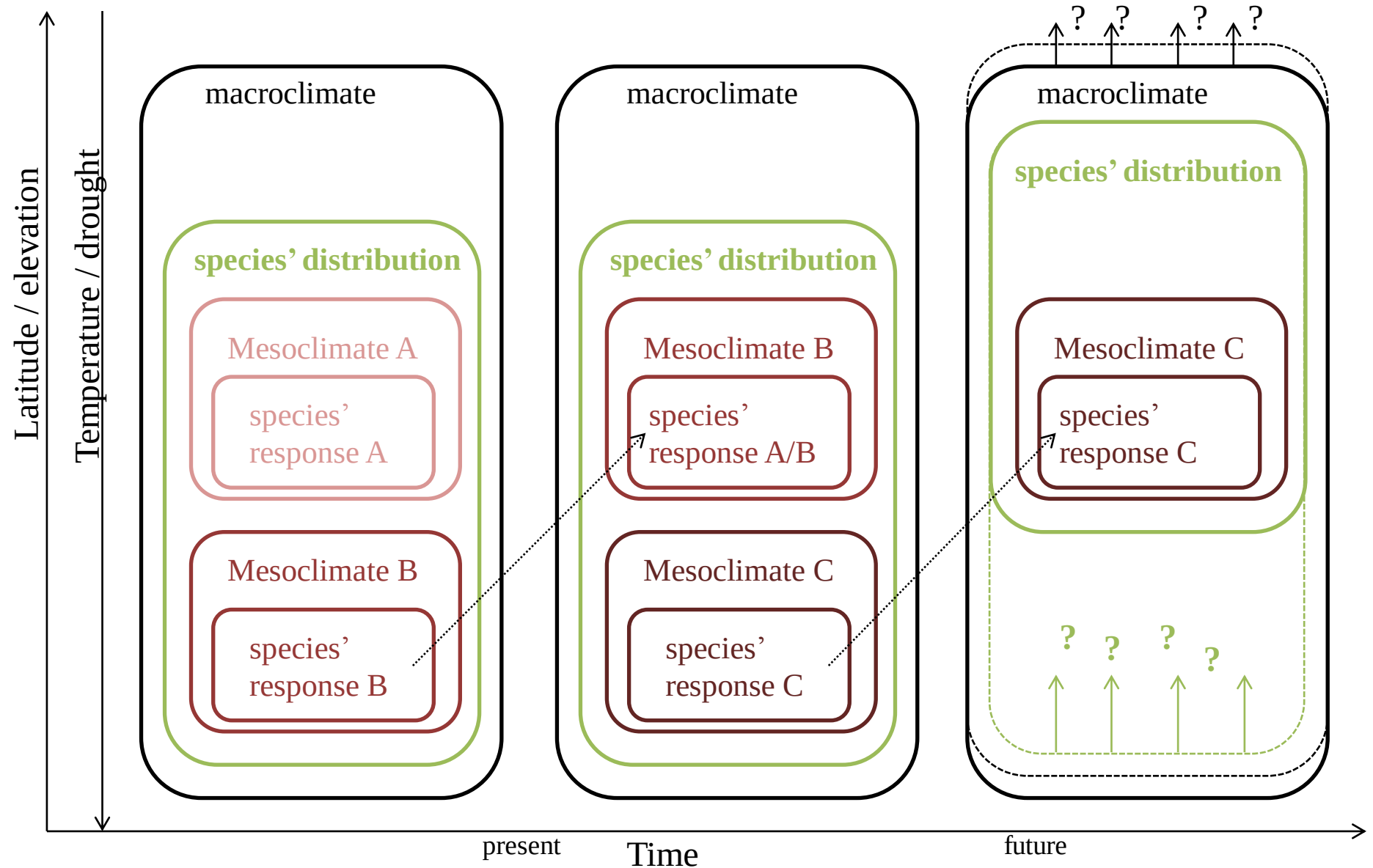
Conclusions

2) Spatio-temporal variability of species-specific response to climate. *Pinus pinea* in Spain



Conclusions

3) Hypothetical implications for vegetation dynamics



Aknowledgements



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