

Tree-rings have not disclosed all their secrets yet: an innovative wood anatomy reveals additional environmental information

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Content

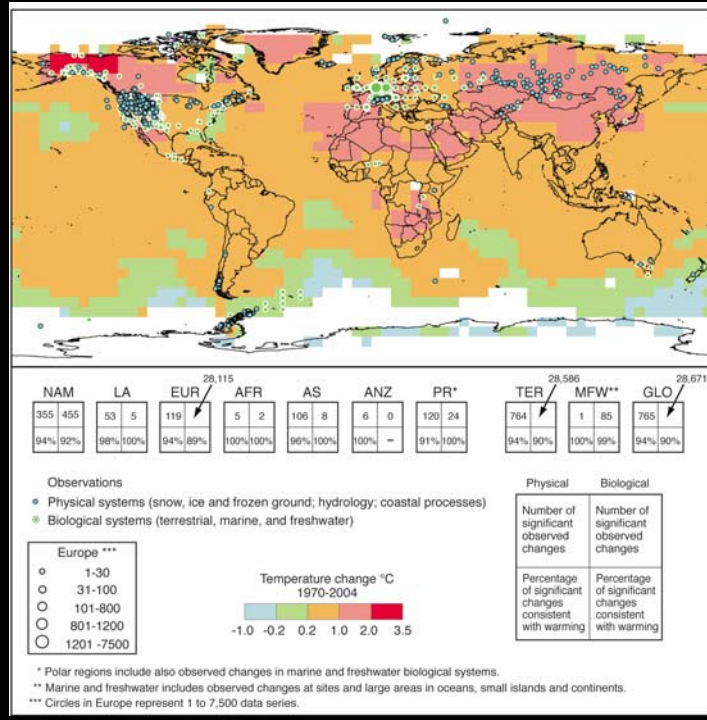
1. Basics

- Why should we expect new information?
- Why are the information only now available?

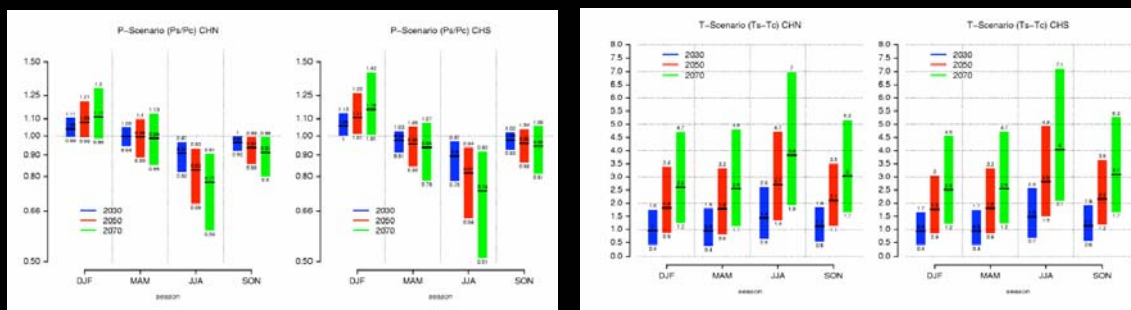
2. Demonstrate potentialities by showing examples based on explorative case studies

Assessing the magnitude of climate change

IPCC (2007)
FAR WG2
Summary for
Policymakers



- good info = accurate models
- Info not always available
- Proxies
 - Ice-cores
 - Pollen deposition
 - Sediments
 - Phenological time-series
 - Historical documents
 - Tree-rings
 - ...



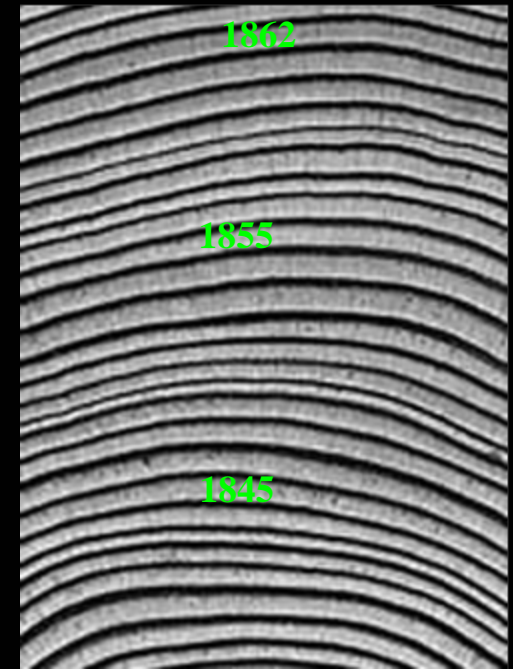
Klimaszenario CH2050

The contribution of tree rings

- Annually datable
- Continuous time series
- "Easy to get" and widespread

Web of science:

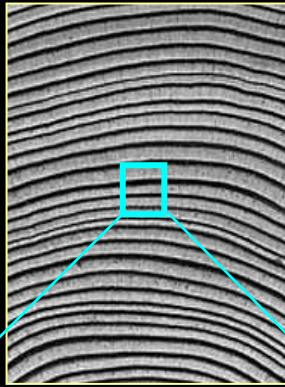
Ca. 2000 scientific papers



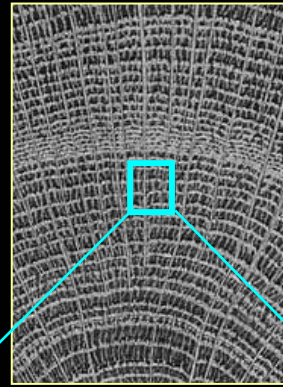
- Extractable information
 - Ring width (DATE, Integrator, P or T, limiting factor)
 - Max Wood Density (summer T)
 - Isotopes (P)

Wood anatomy = Looking into the ring

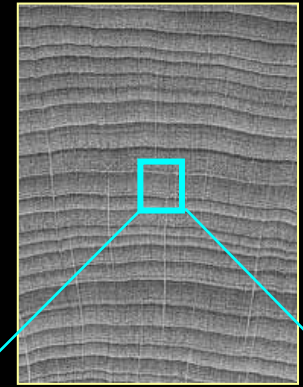
Coniferous wood



Ring porous wood

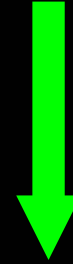
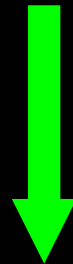


Semi-ring to diffuse porous wood



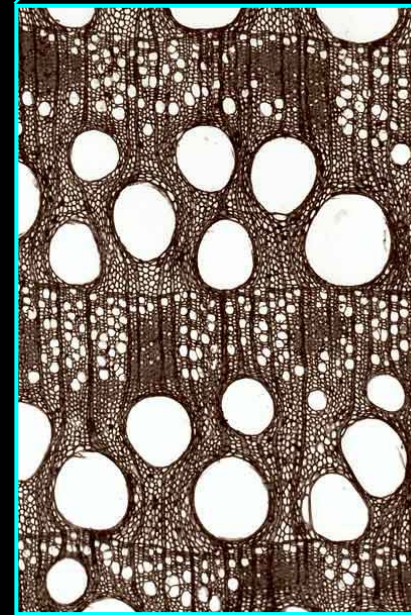
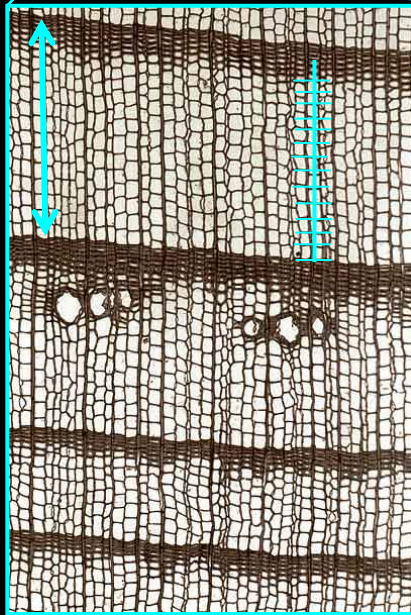
mm

1



μm

n



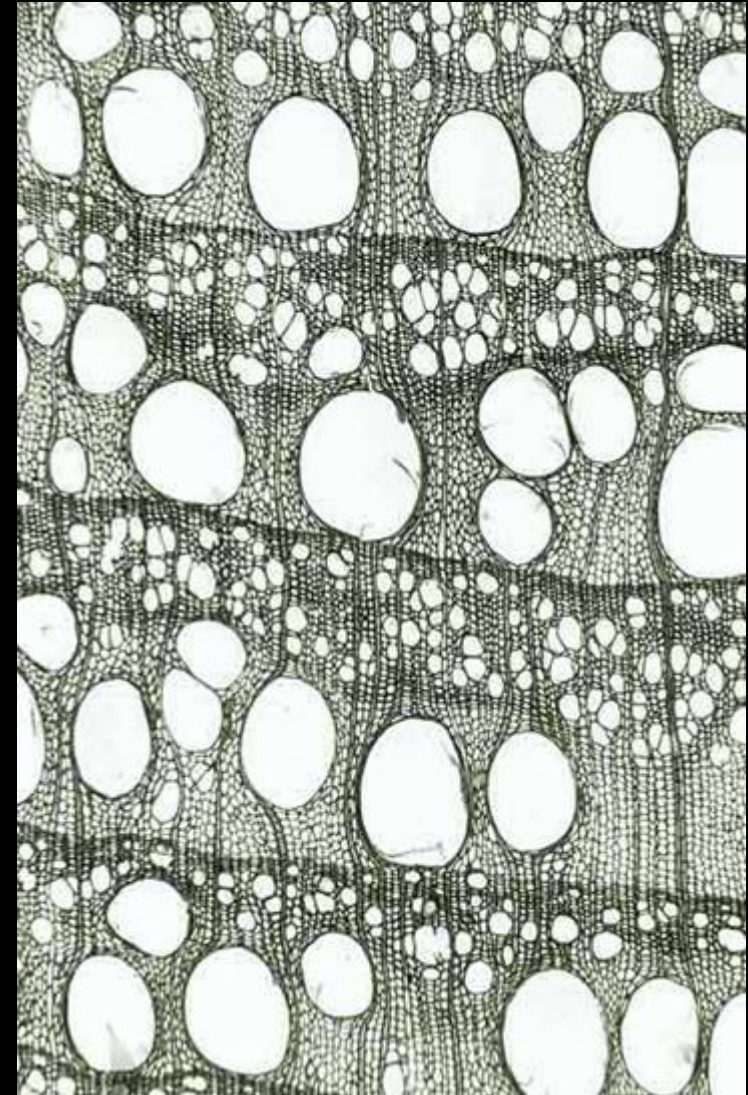
Seasonal

Cambium
physiology

Nowadays

- Technological development
 - Digital camera
 - Computer
 - Image analysis software

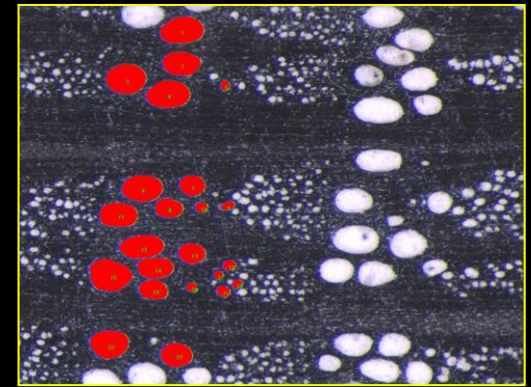
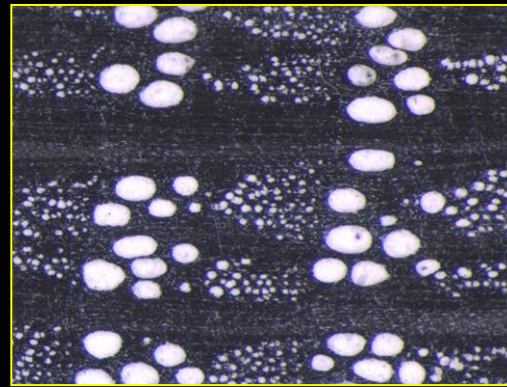
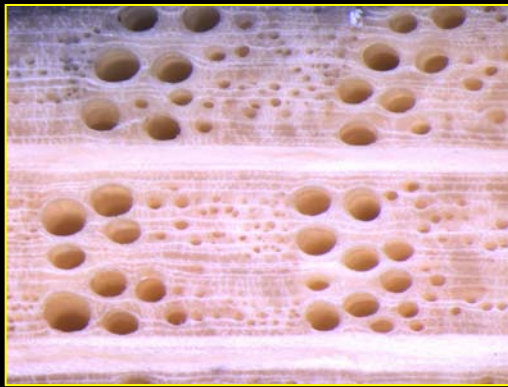
Open field to be explored



Still little obstacles

Ring porous wood

4.5 cm



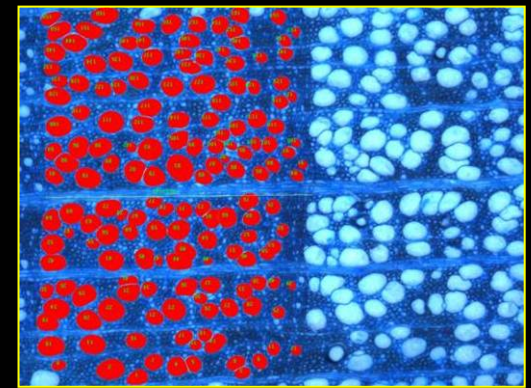
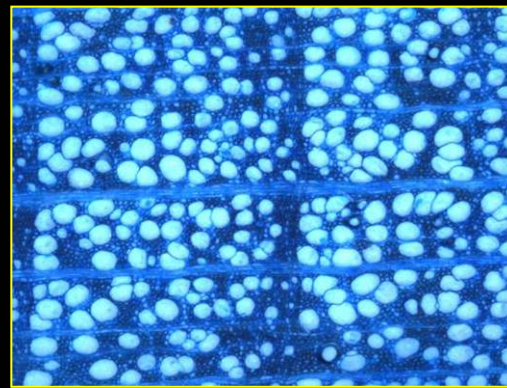
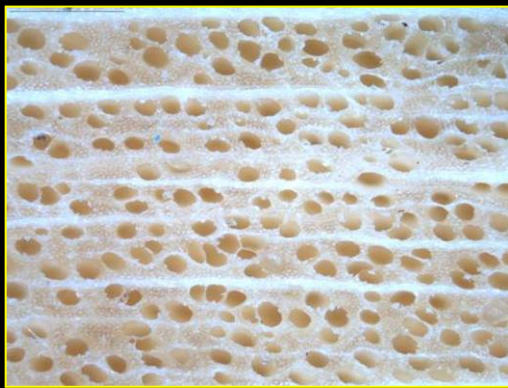
■ Surface quality

■ Contrast

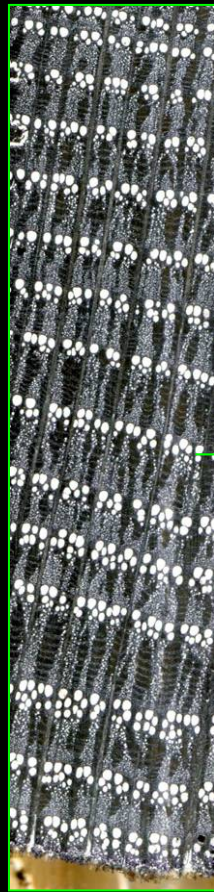
■ Automatic survey

Semi-ring to diffuse porous wood

1.5 cm



Full automatisation



Capturing Image
(Scanner 1500 dpi, 30 MB)



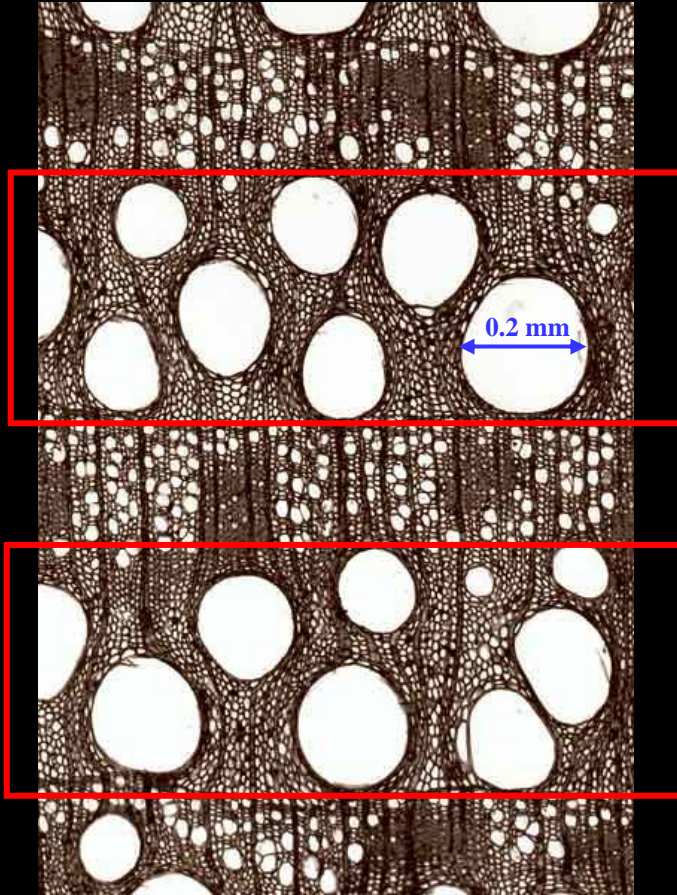
Automatic
ring and vessel recognition



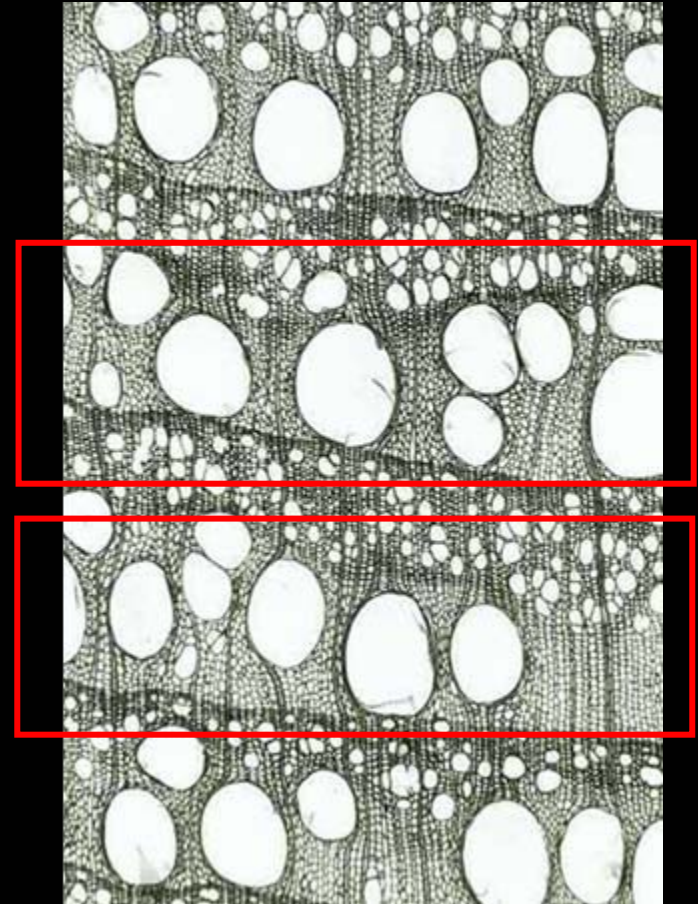
Automatic
Data export

Explorative case studies

Oak



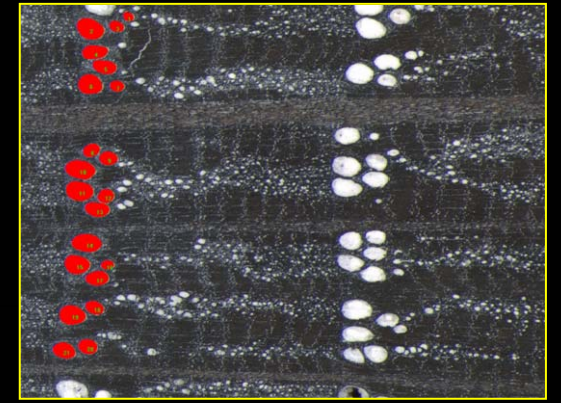
Chestnut



Earlywood vessels

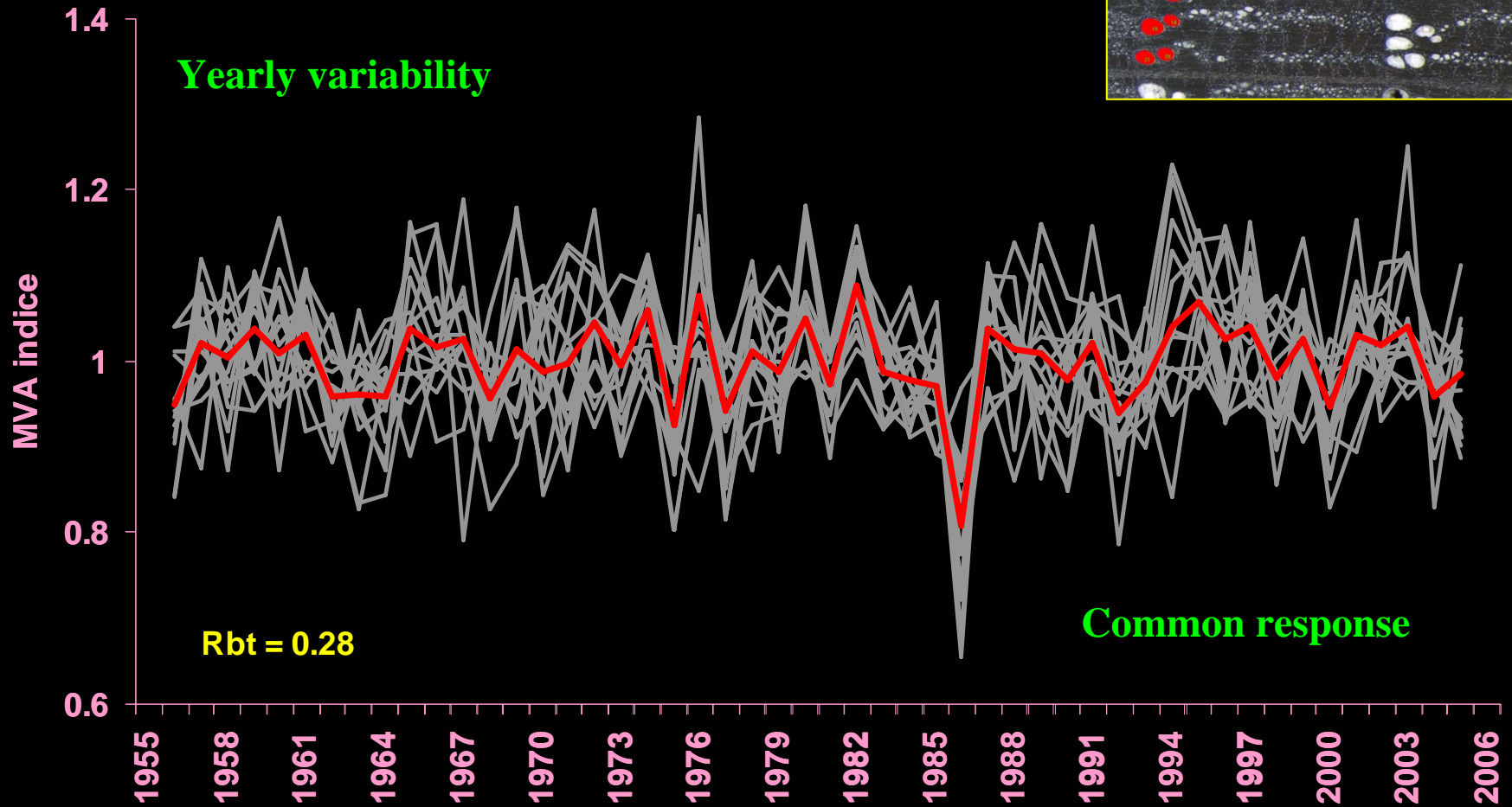
Common signal

MVA: Mean Vessel Area

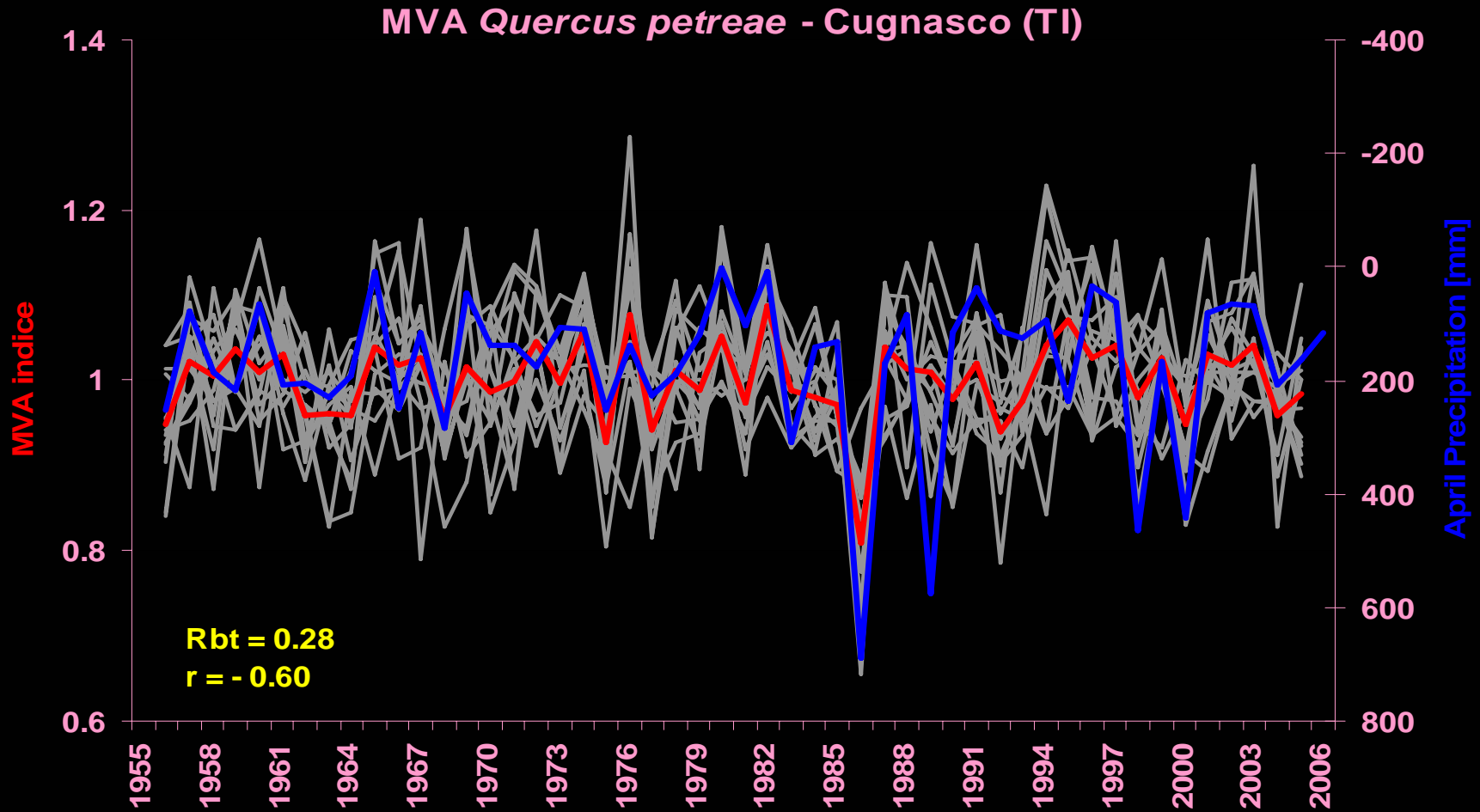


Oak

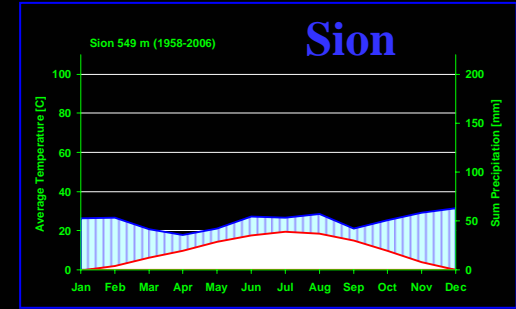
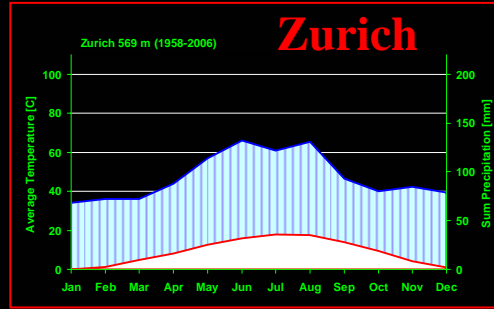
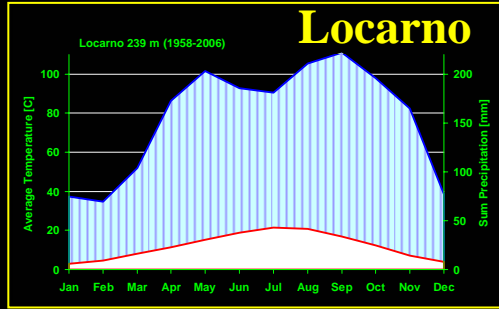
MVA Quercus - Cugnasco (TI)



New information



Outside limiting factor



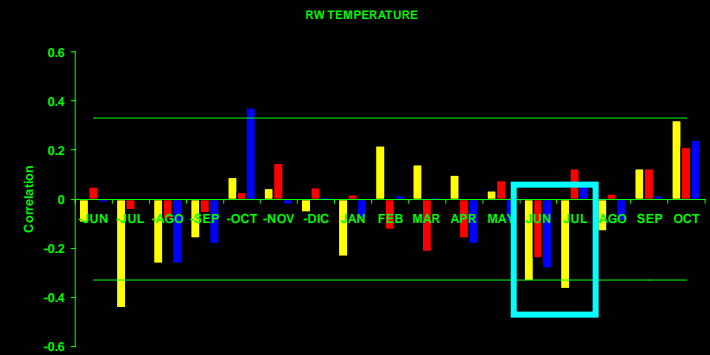
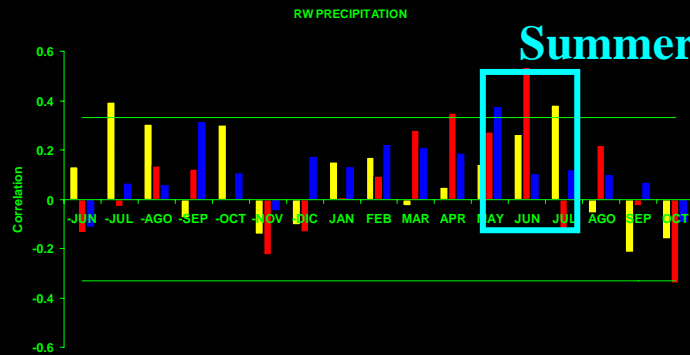
RW

AUTOR

ZUR = 0.12

LOC = 0.27

SIO = 0.28



Precipitation

Temperature

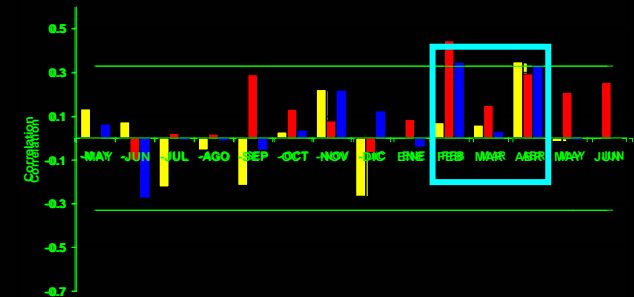
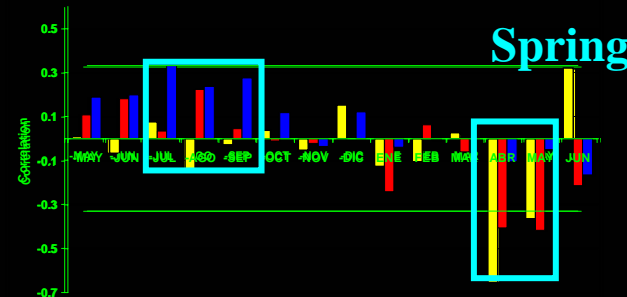
MVA

AUTOR

ZUR = -0.06

LOC = -0.08

SIO = 0.05

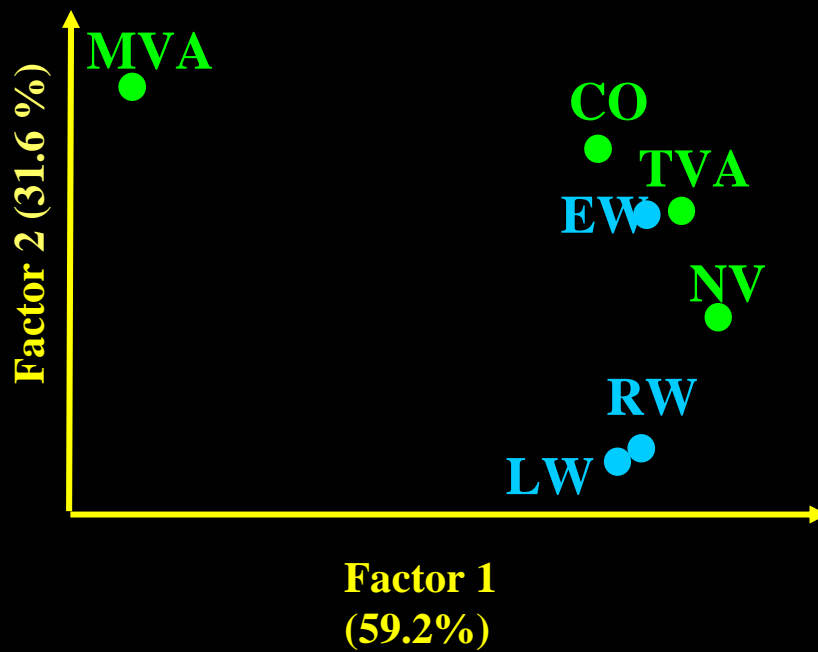
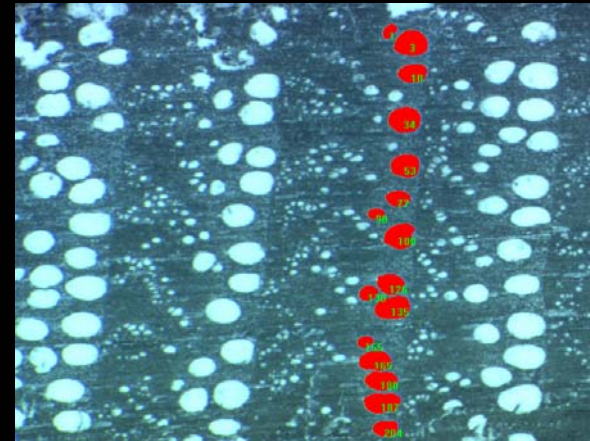


New information

Features:

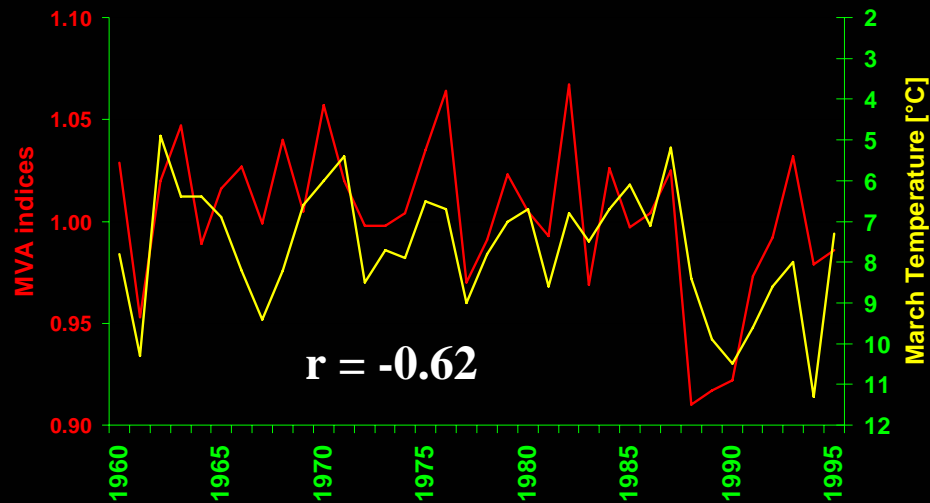
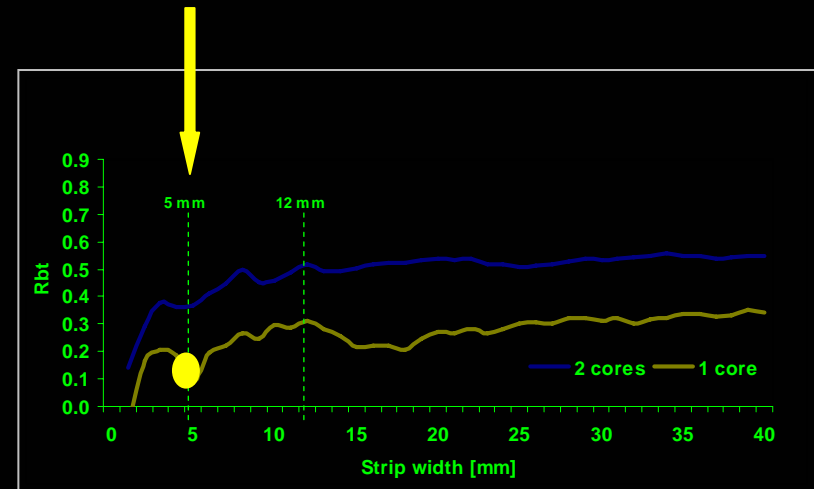
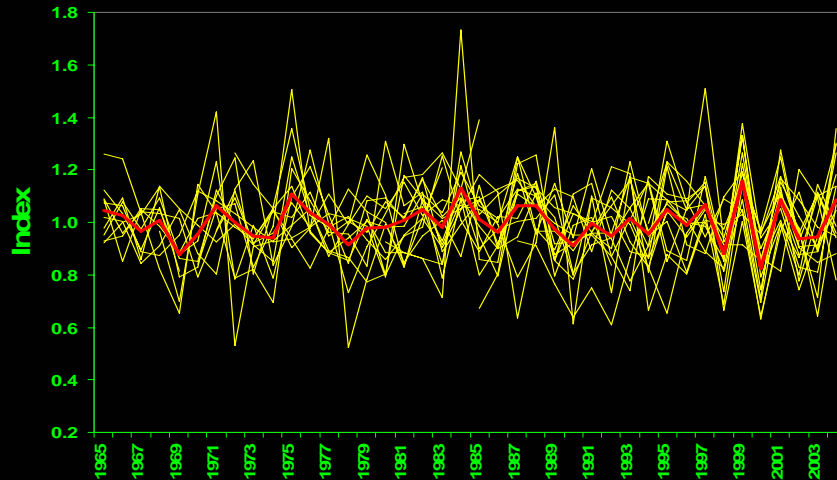
RW NV
 EW MVA
 LW TVA
 CO

Chestnut



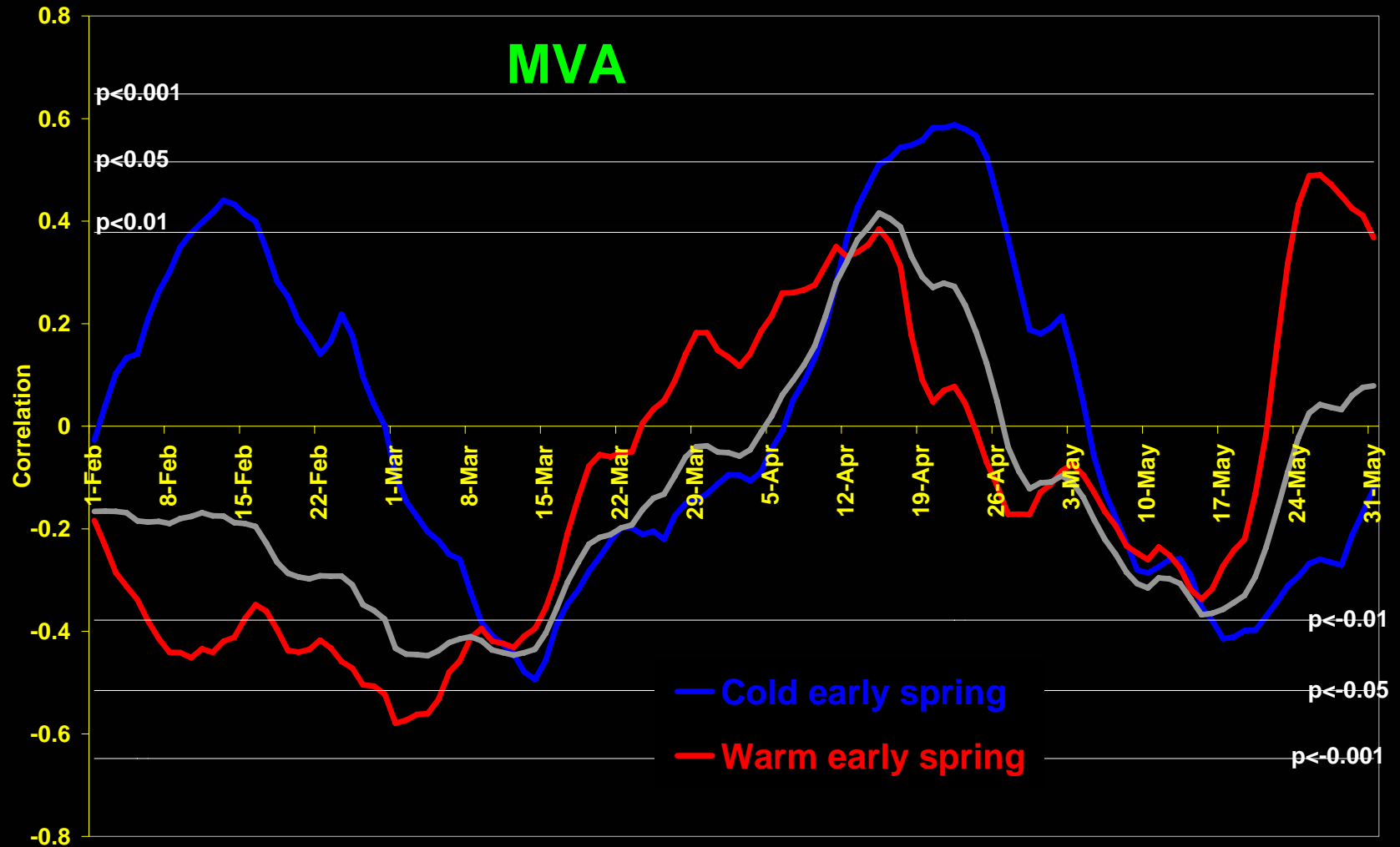
Common signal

MVA, 10 trees, $r_{bt} = 0.17$



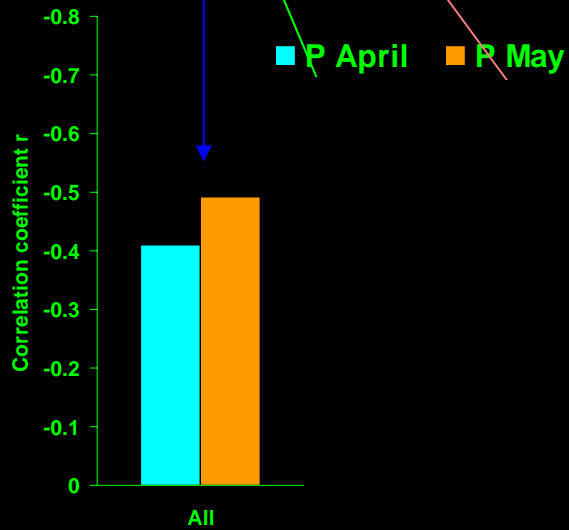
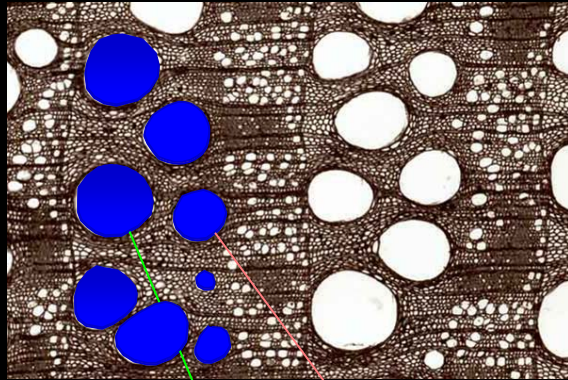
High time resolution

Chestnut

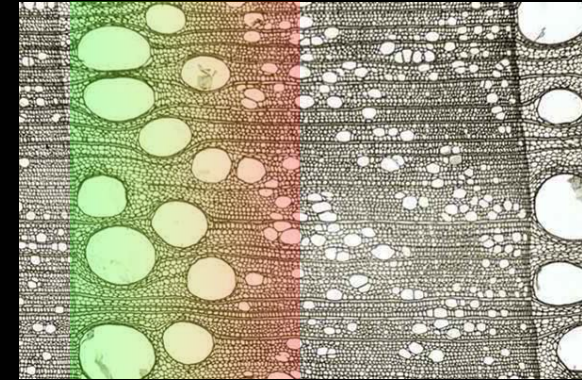


High time resolution

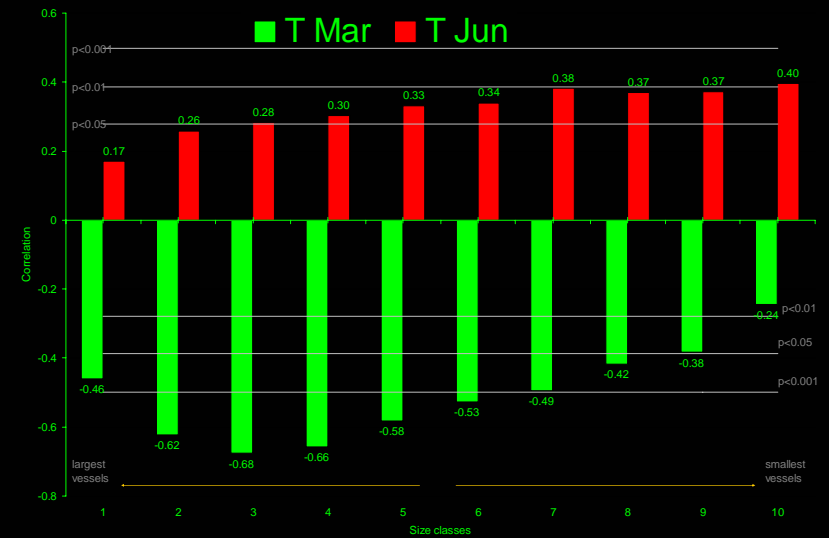
Oak



Chestnut



Cugnasco (TI, CH)
Bedigliora (TI, CH)



Conclusions

- Common signal
- New information
- High time resolution
- Working also under NON-limiting factor
 - → promising for climatic reconstructions

Outlook

- Continue exploration (other species and climatic regions)
- Low frequency signal?
- Mechanistic understanding of the recording
- Ecological indicator

Take home message

- Intra-annual wood anatomical approach
 - → seems promising for climate reconstruction
 - → but needs more exploration