Wood anatomical traits highlight complex temperature influence on Pinus cembra L. at high elevation in the Eastern Alps

WOOD ANATOMICAL TRAITS HIGHLIGHT COMPLEX TEMPERATURE INFLUENCE ON *PINUS CEMBRA* L. AT HIGH ELEVATION IN THE EASTERN ALPS

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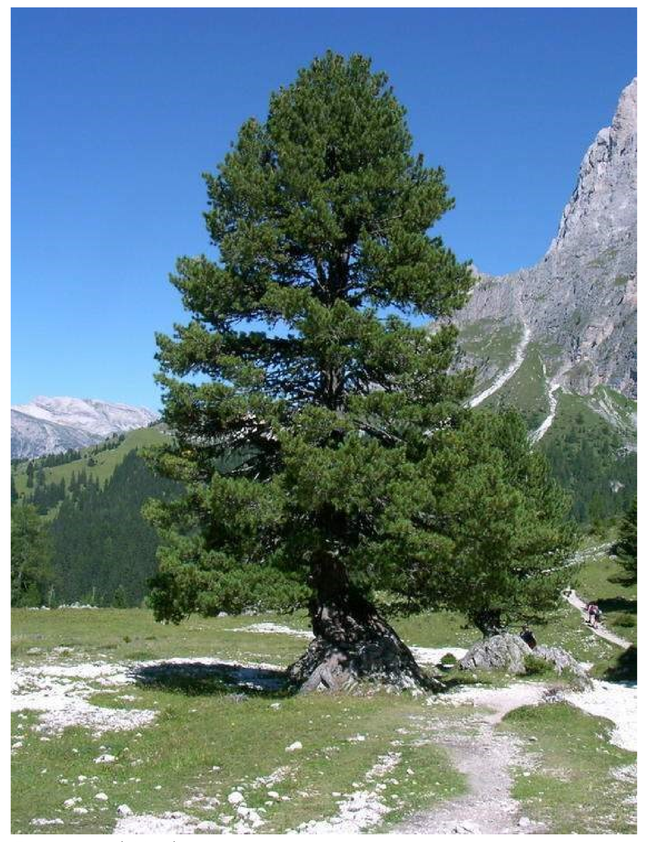

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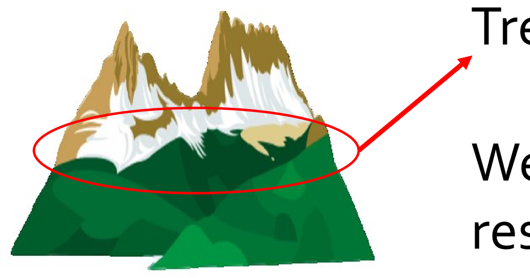
1- BACKGROUND

How tree growth will respond to **future climate** conditions?

Edge population are the most sensitive to climatic variability, thus they are suitable to investigate species response to increasing temperature and changing precipitation pattern (Hampe and Petit 2005).



Tree growth is mostly limited by temperature at the **treeline** (Tranquillini 1979, Körner 2012).

We therefore selected a typical high-elevation species, ***Pinus cembra* L.**, and assessed its growth response to temperature and precipitation variability through **dendroanatomical analysis.**

2- OBJECTIVES

GENERAL: To better understand xylem growth mechanisms of edge populations in response to future climate conditions.

SPECIFIC: To get high-resolution climate-growth associations in a typical high-elevation species.

3- METHODS

STUDY SITE: Croda da Lago (Eastern Alps, IT), 2100 m a.s.l.

SAMPLE SIZE: 9 trees and 1.5×10^6 tracheids.

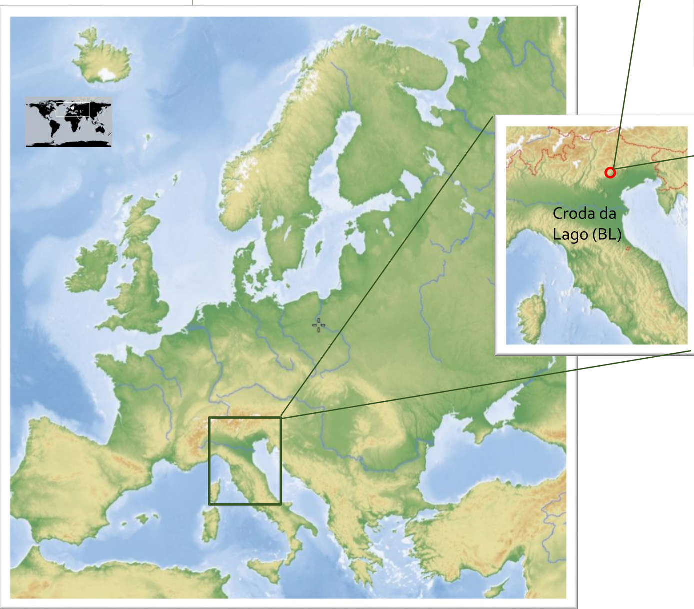
XYLEM TRAITS:

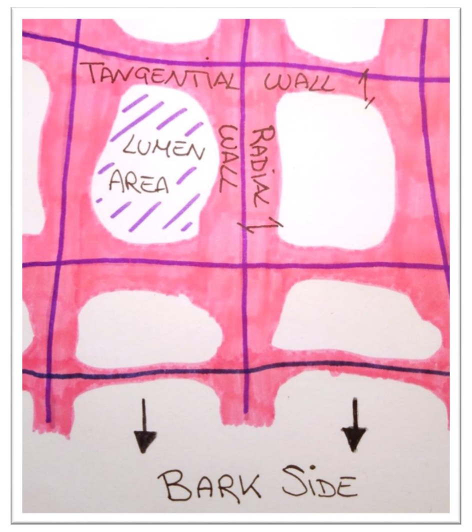
- Mean ring width
- Number of cells per ring

} Ring level

- Mean lumen area
- Radial cell wall thickness
- Tangential cell wall thickness

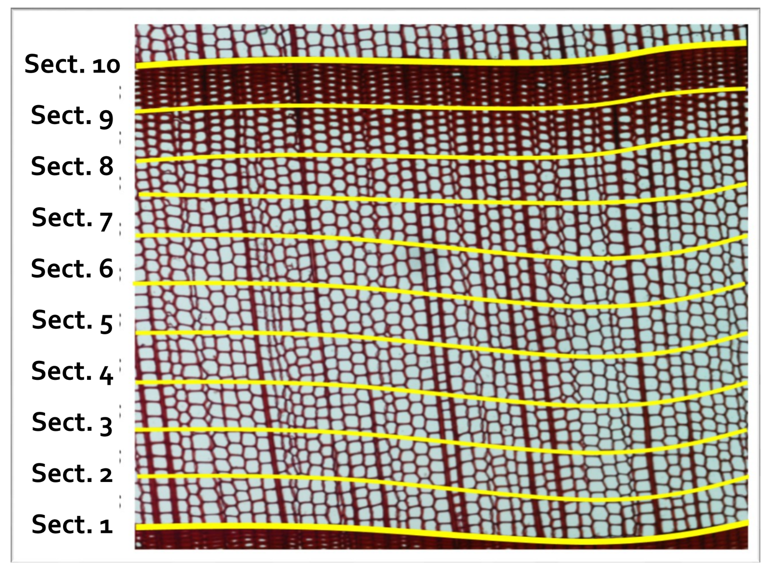
} Intra-ring level: i.e. ring sectors





CLIMATE DATA: Daily temperature and precipitation records from 1926 to 2014.

CLIMA-GROWTH ASSOCIATIONS: 15-day running correlations from April to September.



4- RESULTS

- **PCA** highlighted that different traits and sectors behaved differently from each other's (Fig. 1).
- **Temperature**, in late-spring and summer, was the main climatic driver, while **precipitation** influence was marginal (results not shown).
- **Cell wall thickness** featured the most extended time window sensitivity (Fig. 2).
- **Anisotropy** in the responses. Higher and longer sensitivity in radial respect to tangential cell wall thickness (Fig. 2).

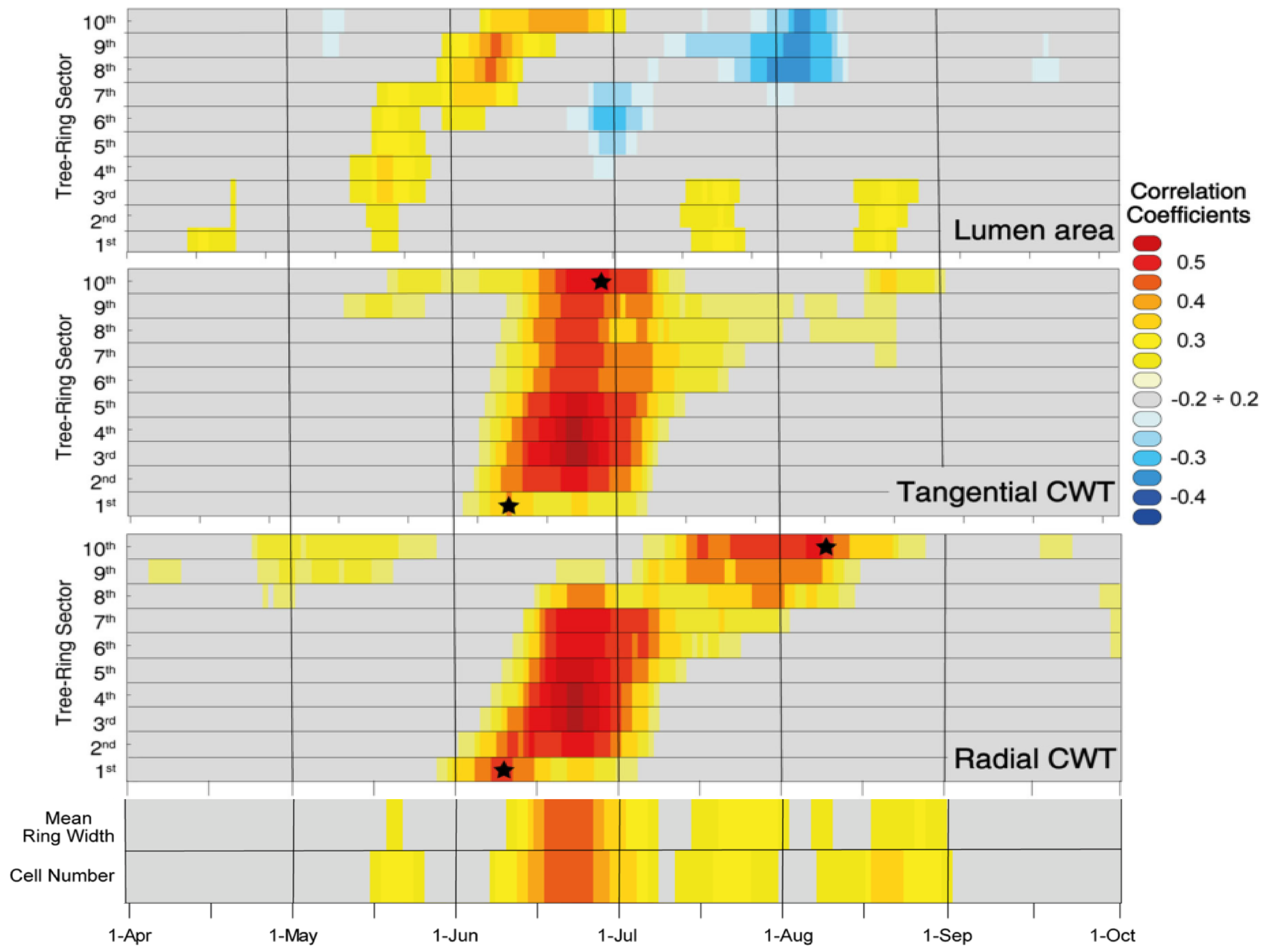


Fig. 2: Associations between temperature and anatomical chronologies over the period 1926–2014 on 15-day windows. Gray cases are not significant, colored boxes are significant (p < 0.05, color key on the right), black marks highlight the peak of correlation in the 1st and 10th CWT sectors

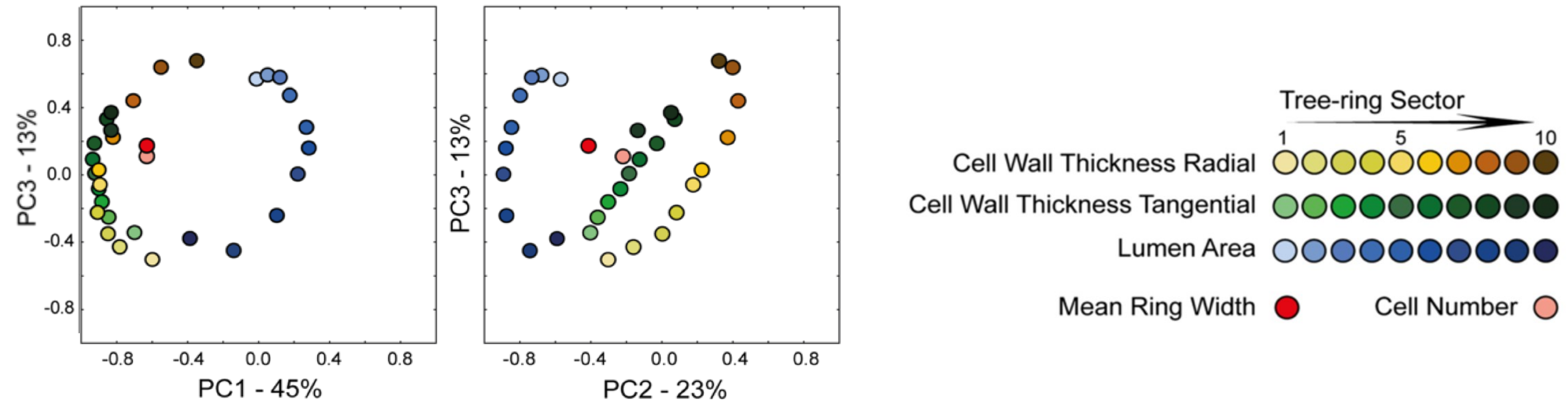


Fig. 1: Scatter plots of weighting coefficients for the three significant principal components (PCs) computed on tree-ring width and anatomical trait chronologies for 10 tree-ring sectors. Color shading of the circles refers to sectors ranging from earlywood (light) to latewood (dark). Axis labels report the percentage of variance expressed by each component

5- CONCLUSION

- **Temperature** strongly influences xylem structure of *Pinus cembra* L. at its elevational limit. **Cell wall thickness** is the most sensitive trait.
- **Anisotrophy** between radial and tangential wall could give new perspective for future research.
- **Dendroanatomical analysis** improved the quality of the climate-growth associations both in terms of time resolution and significance of the results respect to the classical tree-ring width analysis.

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