

Reconstructing precipitation regimes over the last millennium from oak earlywood vessels

Research background

In many areas of the world where there is a strong seasonality in either temperature or rainfall, trees species form clear annual growth rings. As more and more rings grow over the lifetime of these trees, they form a record of year-to-year changes in climate, often stretching across hundreds and sometimes thousands of years. These records are the primary resource of the science of *Dendroclimatology* - the study of the relationships between climate and tree-growth parameters and their use in the reconstruction of past climates.

The most widely used parameters in dendrochronology are tree ring width and maximum latewood density, as these measures are directly affected by the prevailing climatic conditions during the growing season. Similarly, wood cell anatomical features such as cell size should also encode valuable climatic information. Time series of such cell anatomical characteristics might provide additional information about seasonal climatic variability.

Distinct spring precipitation signals have been obtained from annual changes in the size of earlywood vessels of living oak (*Quercus sp.*). Despite the potential to supply technique for obtaining rare information about seasonal precipitation signals for mesic sites in Europe, no long-term reconstructions from earlywood vessels currently exist.

In our **Dendro Sciences Unit** at the WSL, a method for rapid image analysis based on semi-automatic measurement of earlywood vessels has been developed. Archaeological oak samples spanning the last millennia are available from the **Labor für Dendrochronologie** for measurement. The successful applicant will collaborate with both labs in the development of a long-term reconstruction of precipitation for the Swiss plateau using oak earlywood vessels.

Aim

To build a 1000-year long chronology of earlywood vessels size and use it to reconstruct past precipitation regimes in northern Switzerland

Methods

- Measure and cross-date tree-ring widths
- Measure earlywood vessels on dated rings with image analysis
- Identify, calibrate and reconstruct the climatic signal
- Write a scientific report

Referenten

[Patrick Fonti](http://www.wsl.ch/personal_homepages/fonti), WSL (http://www.wsl.ch/personal_homepages/fonti)
Niels Bleicher, Labor für Dendrochronologie

Links and references

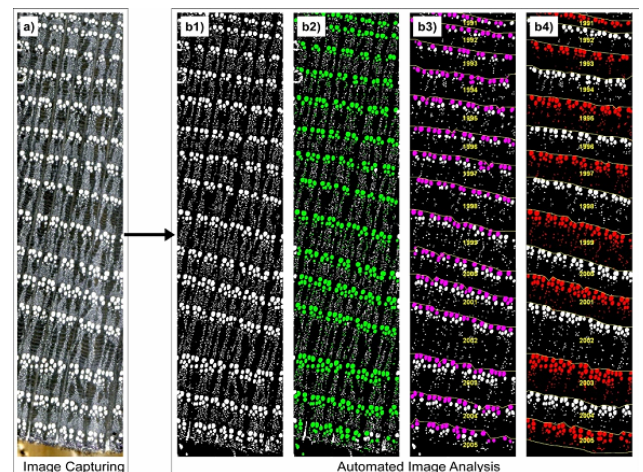
[Introduction to Dendrochronology](http://web.utk.edu/~grissino) (web.utk.edu/~grissino)
[Tree-ring anatomy with image analysis at the WSL](http://www.wsl.ch/personal_homepages/fonti/Projecte_EN)
(www.wsl.ch/personal_homepages/fonti/Projecte_EN)
[WSL Dendro Science Unit](http://www.wsl.ch) (www.wsl.ch;
www.wsl.ch/forschung/forschungsunits/dendro)
[Labor für dendrochronologie](http://www.stadt-zuerich.ch/hbd/de/index/archaeologie_denkmalpflege_u_baugeschichte/dendro.html) (www.stadt-zuerich.ch/hbd/de/index/archaeologie_denkmalpflege_u_baugeschichte/dendro.html)

Your profile

You have a background in natural sciences and are motivated about learning innovative dendrochronological methods.

Interested?

For further information, please contact Dr. Patrick Fonti To apply, please send your letter of interest, CV, and addresses of potential referees to patrick.fonti@wsl.ch.



Example of an automated earlywood vessel measurement from a digital image. a) Cut-out of a *Quercus robur* core cross-section digital image captured with a high-resolution and distortion-free digital scanner. **b)** Procedures for an automated vessel recognition and measurement using an image analysis tool ("ROXAS"). After improving image contrast, the image is segmented into a binary image (**b1**). Vessels (green objects) are identified based on area and morphometric characteristics (**b2**). Annual ring borders (yellow lines) are defined based on the position of the largest (earlywood) vessels (in purple; **b3**). Misidentified ring boundaries and vessels were corrected using a manual editing mode. Finally, recognised vessels are assigned to the corresponding annual ring (alternatively coloured red and white; **b4**) anatomical measurement of each single vessel is exported into a spreadsheet file.