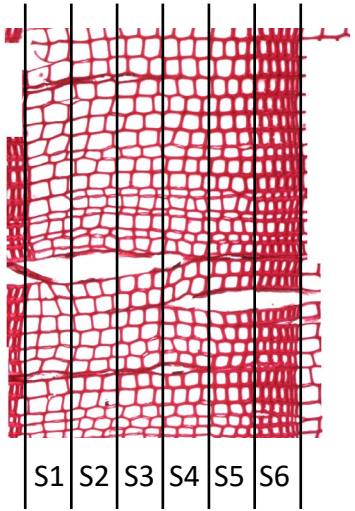
ECL7202 – DENDROECOLOGY

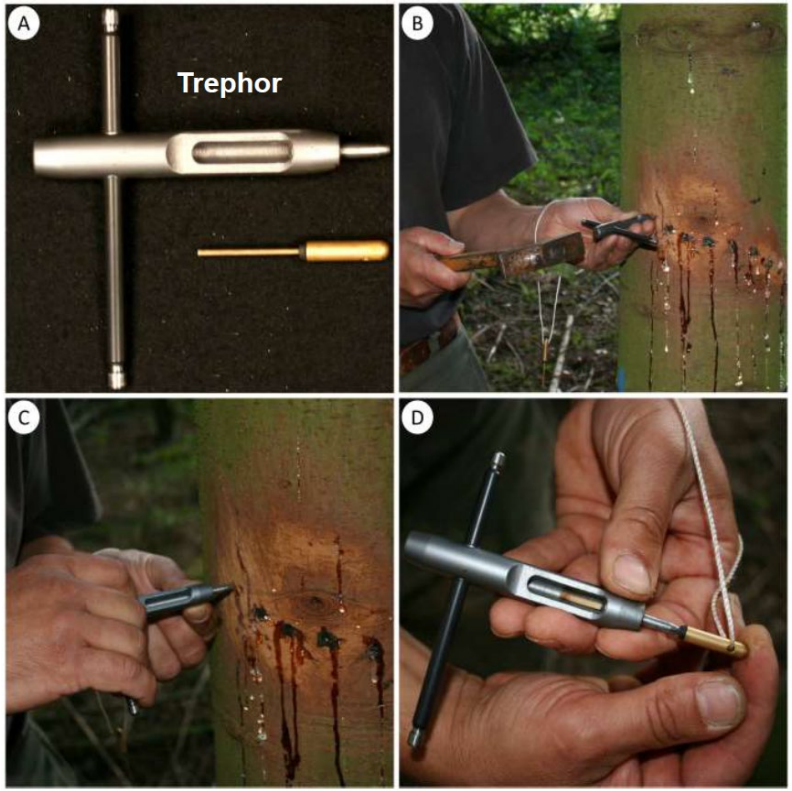
4 – Dendroecology at the intra-annual scale

A posteriori intra-annual monitoring



We divide a ring of a core into subsections to analyze the traits in each subsection

Real-time intra-annual monitoring

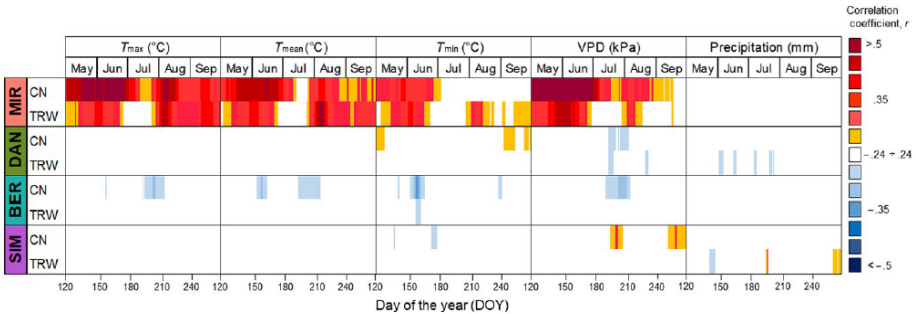


Cuny 2015

We follow the formation of the ring during the growing season

Why is intra-annual monitoring interesting?

TRW vs Temperature correlation

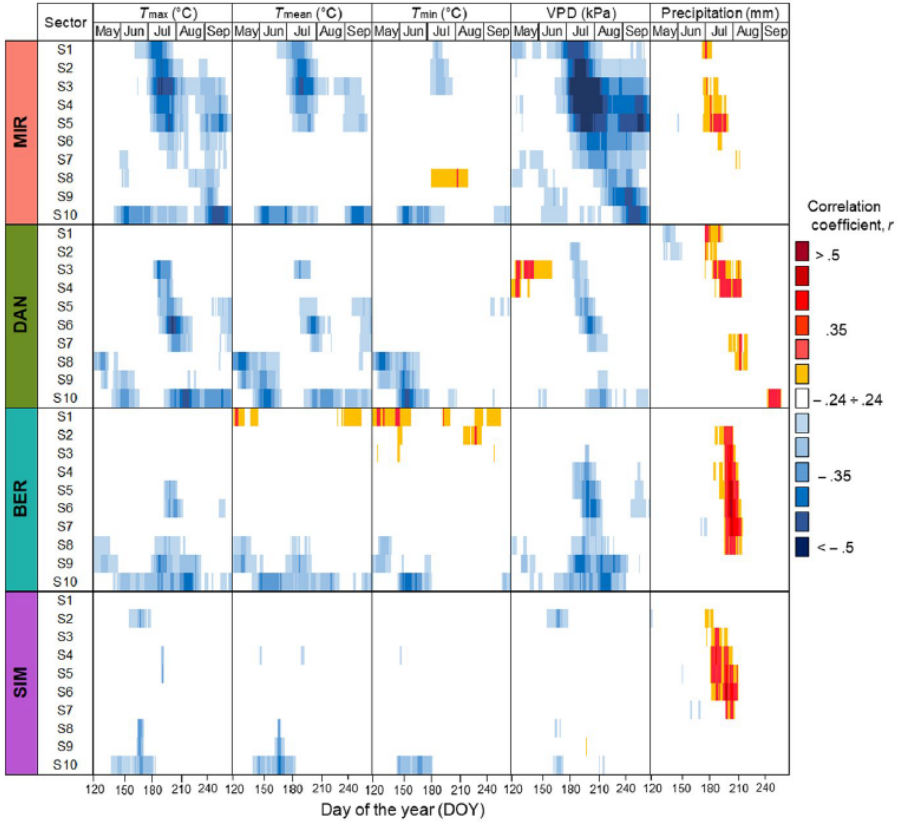


At the interannual scale we can miss the importance of certain processes:

Here, the trees show no sign of water / heat stress on an interannual scale (see above)

On the other hand, on an intra-annual scale, water / heat stresses are evident (see right)

Lumen area vs Temperature correlation

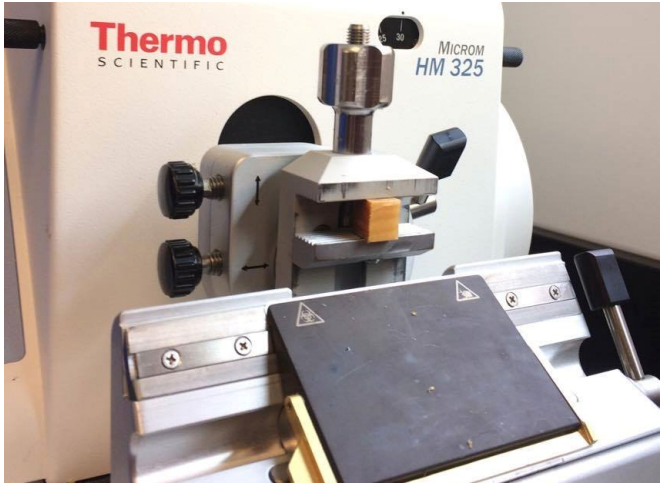


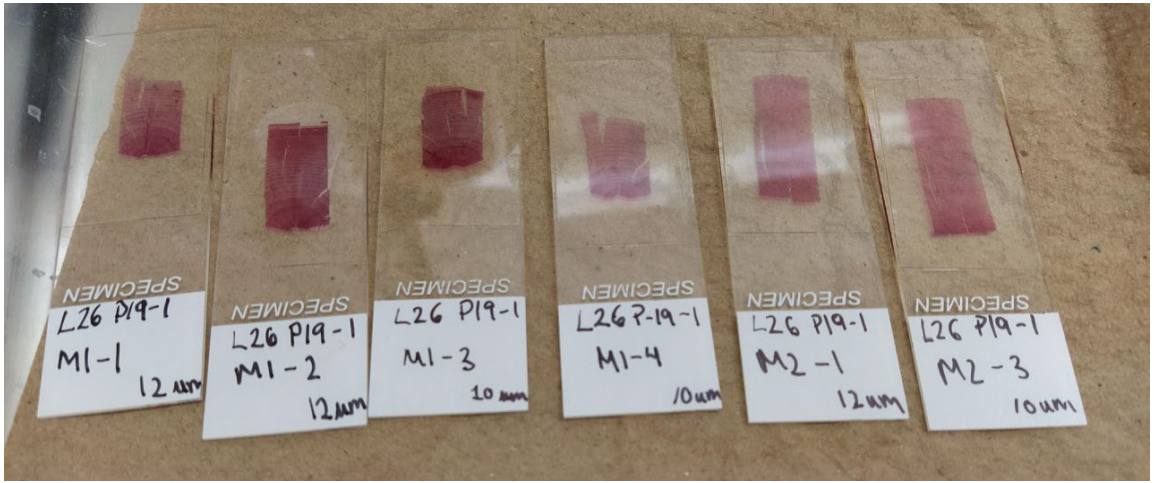
Puchi, P. F., Castagneri, D., Rossi, S., & Carrer, M. (2020). Wood anatomical traits in black spruce reveal latent water constraints on the boreal forest. *Global Change Biology*, *26*(3), 1767–1777. doi: 10.1111/gcb.14906

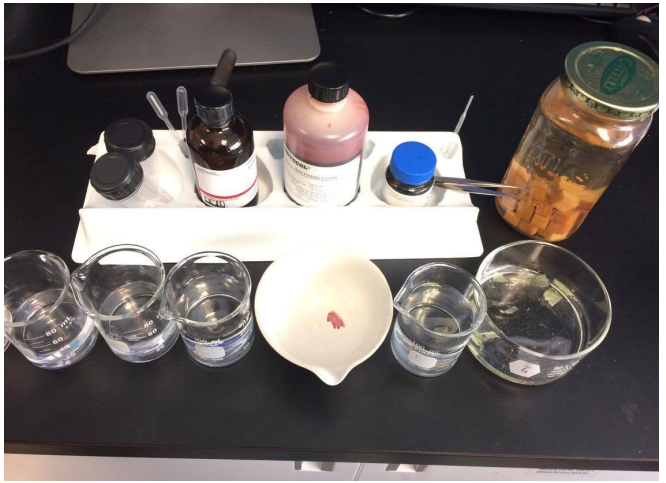
A posteriori intra-annual monitoring : Anatomy

Steps:

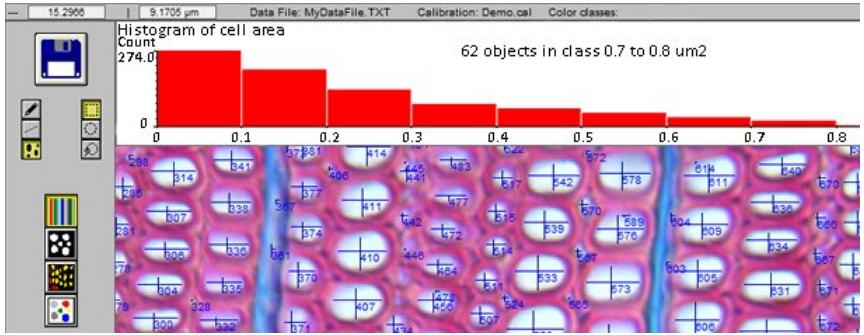
1. Preparation of samples and microtome sectioning
2. Dehydration, staining and mounting of slides
3. Image capture under the microscope

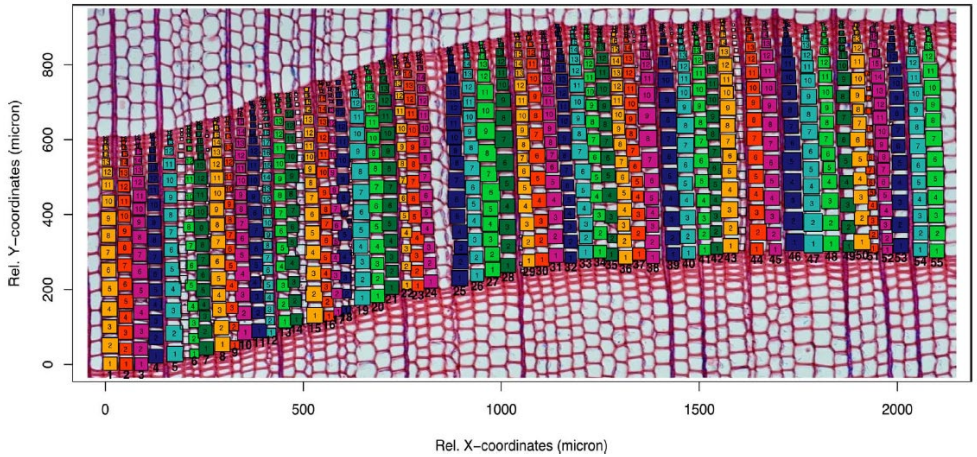






A posteriori intra-annual monitoring : Anatomy

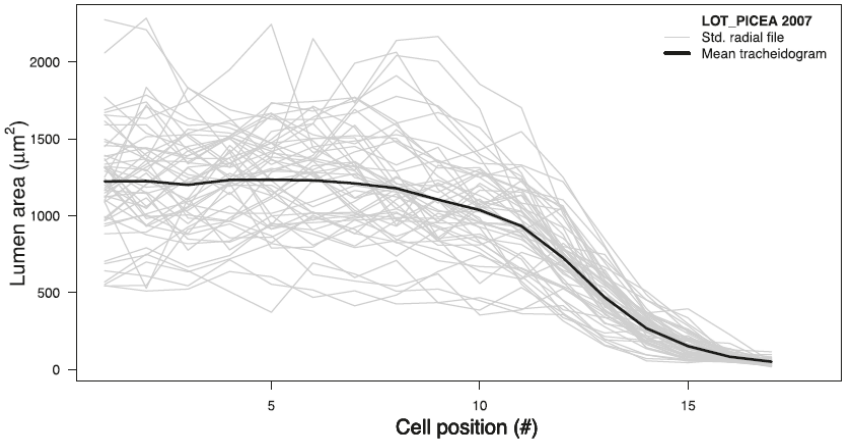




Steps:

4. Image analysis
5. Development of tracheidograms

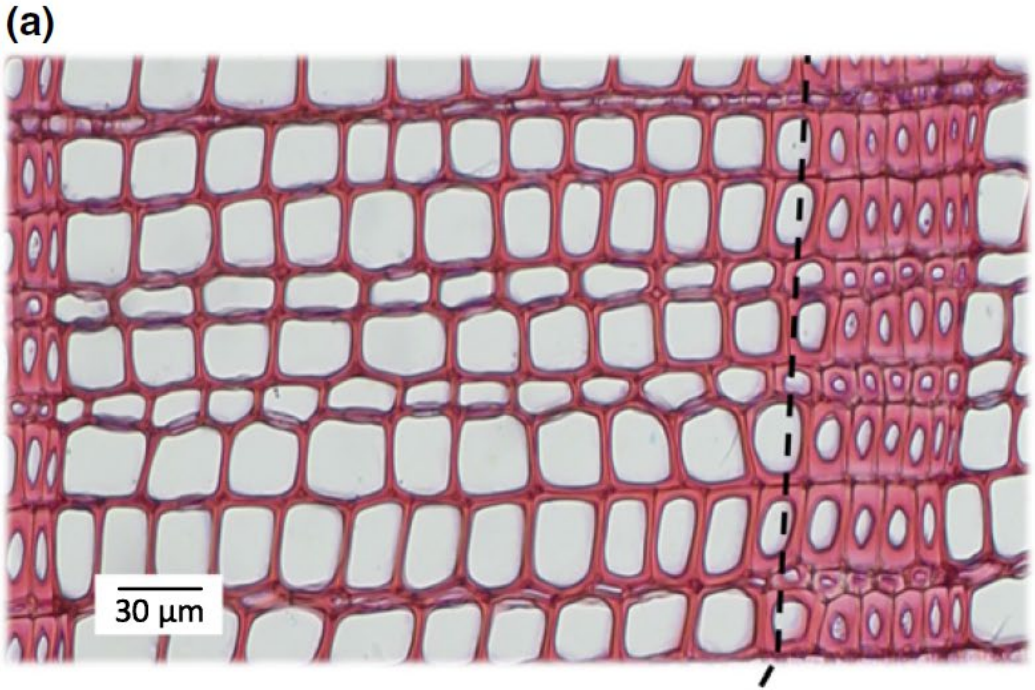
A tracheidogram

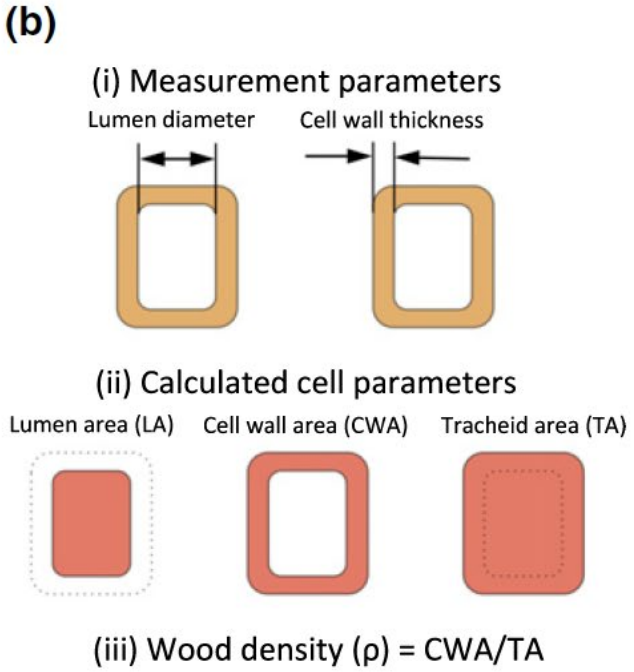


Peters, R. L., Balanzategui, D., Hurley, A. G., von Arx, G., Prendin, A. L., Cuny, H. E., … Fonti, P. (2018). RAPTOR: Row and position tracheid organizer in R. *Dendrochronologia*, *47*, 10–16. doi: https://doi.org/10.1016/j.dendro.2017.10.003

A posteriori intra-annual monitoring : Anatomy

The different anatomical traits

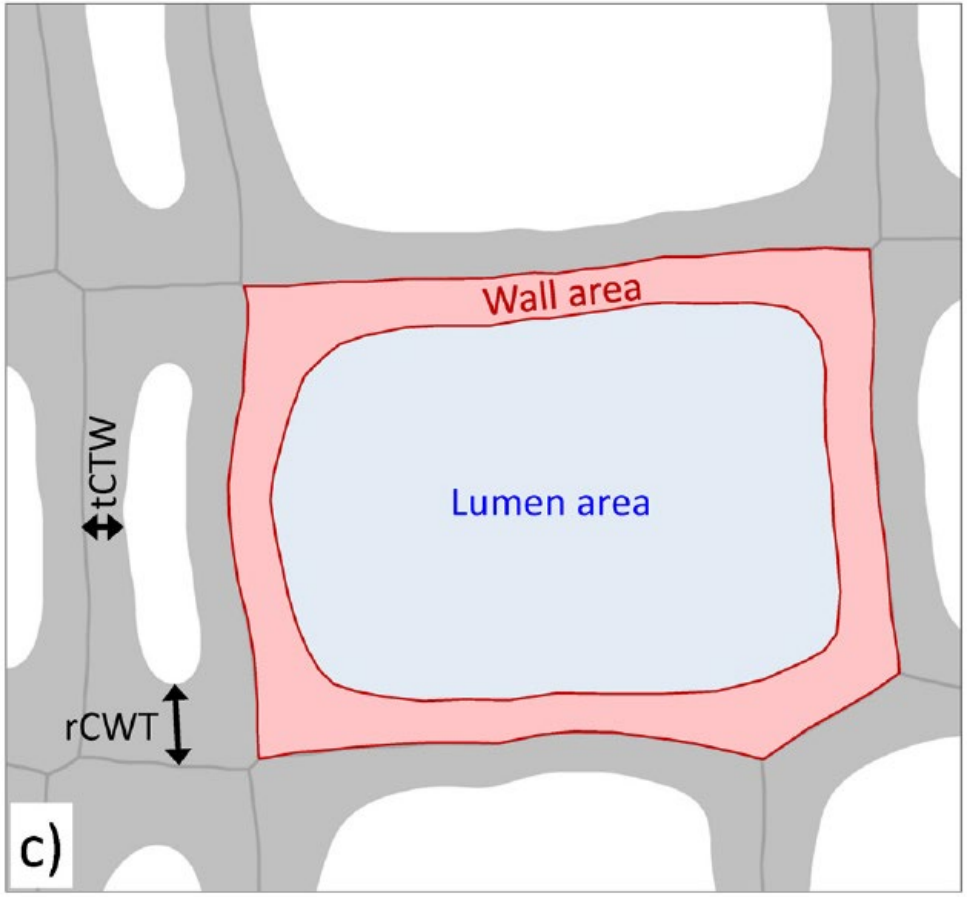




Björklund, J., Seftigen, K., Schweingruber, F., Fonti, P., von Arx, G., Bryukhanova, M. V, … Frank, D. C. (2017). Cell size and wall dimensions drive distinct variability of earlywood and latewood density in Northern Hemisphere conifers. *New Phytologist*, *216*(3), 728–740. doi: 10.1111/nph.14639

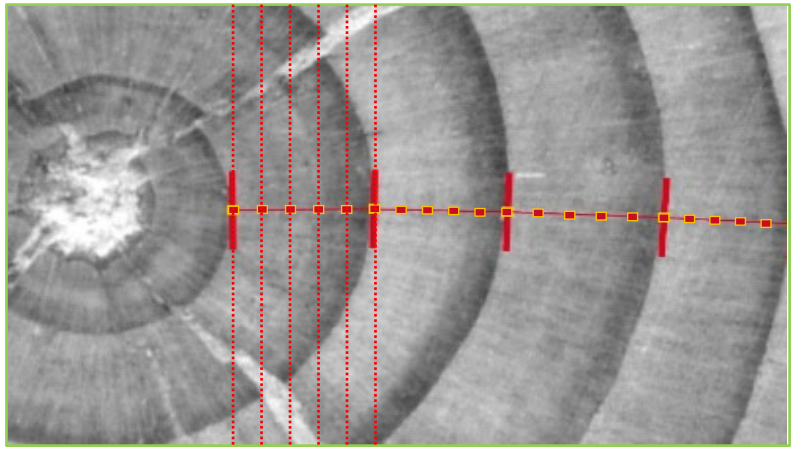
A posteriori intra-annual monitoring : Anatomy

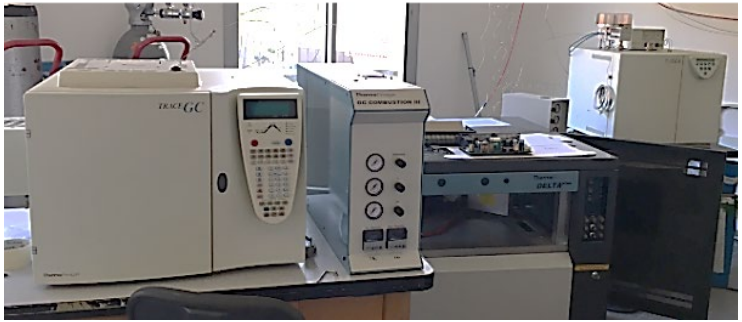
The different anatomical traits



A posteriori intra-annual monitoring : stable isotopes of cellulose

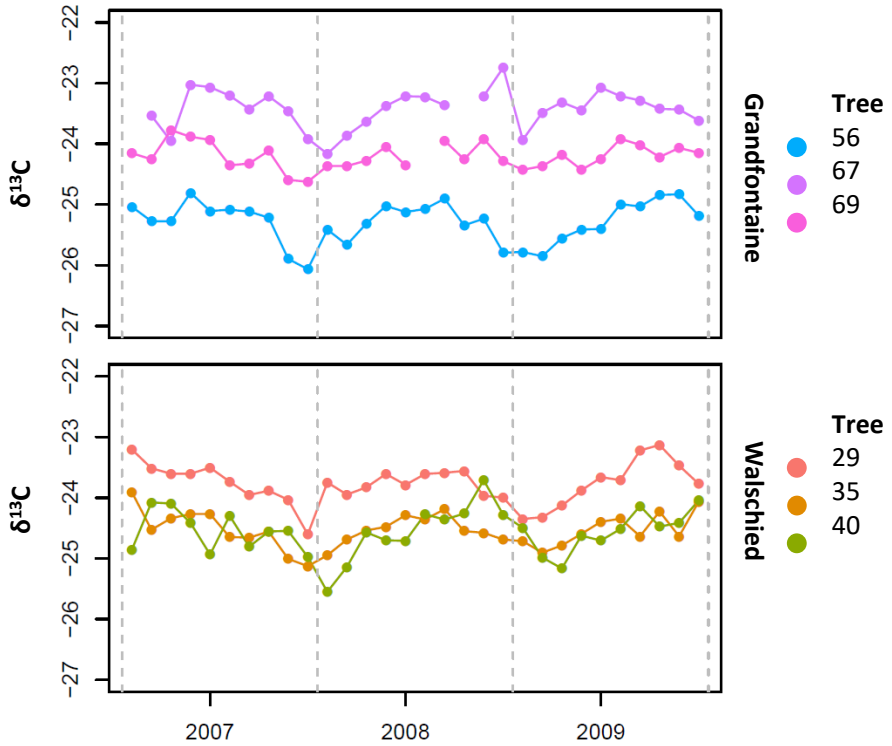
We cut each ring into several sections





Steps:

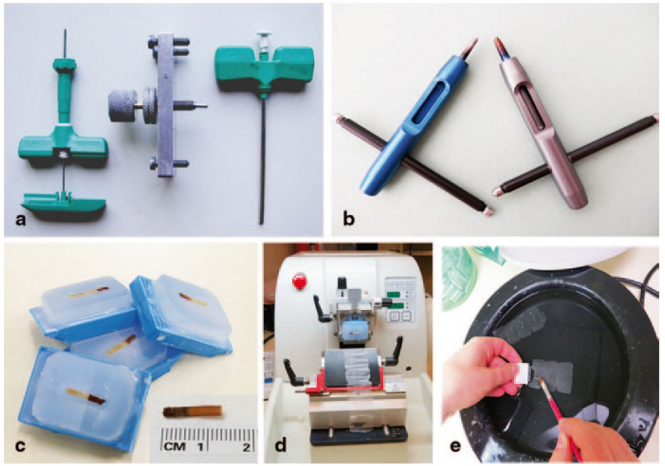
1. Cutting, grinding and cellulose cextraction
2. Mass spectrometer analysis
3. Development of time series

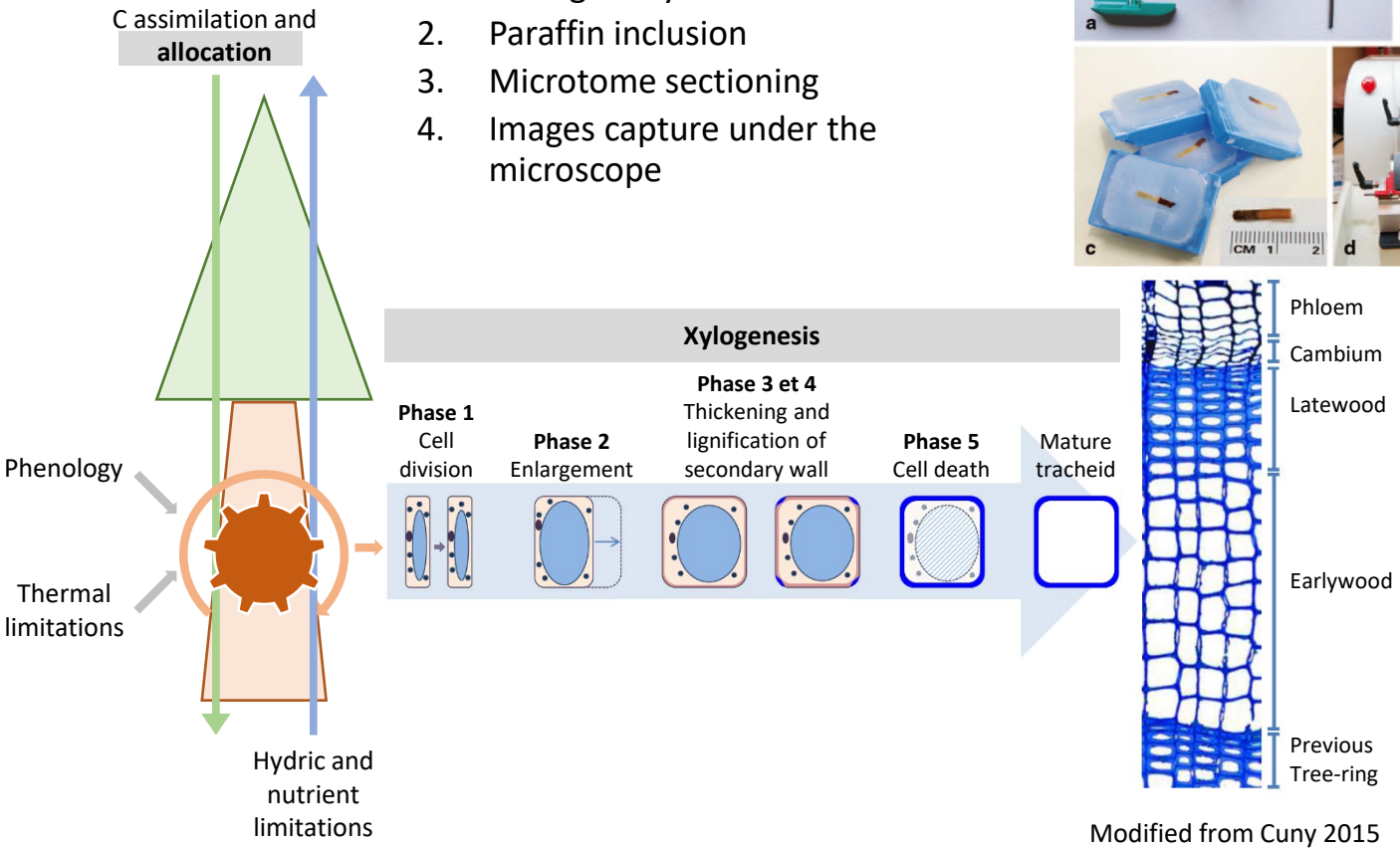


Real-time intra-annual monitoring : Xylogenesis

Steps:

1. Coring every week
2. Paraffin inclusion
3. Microtome sectioning
4. Images capture under the microscope



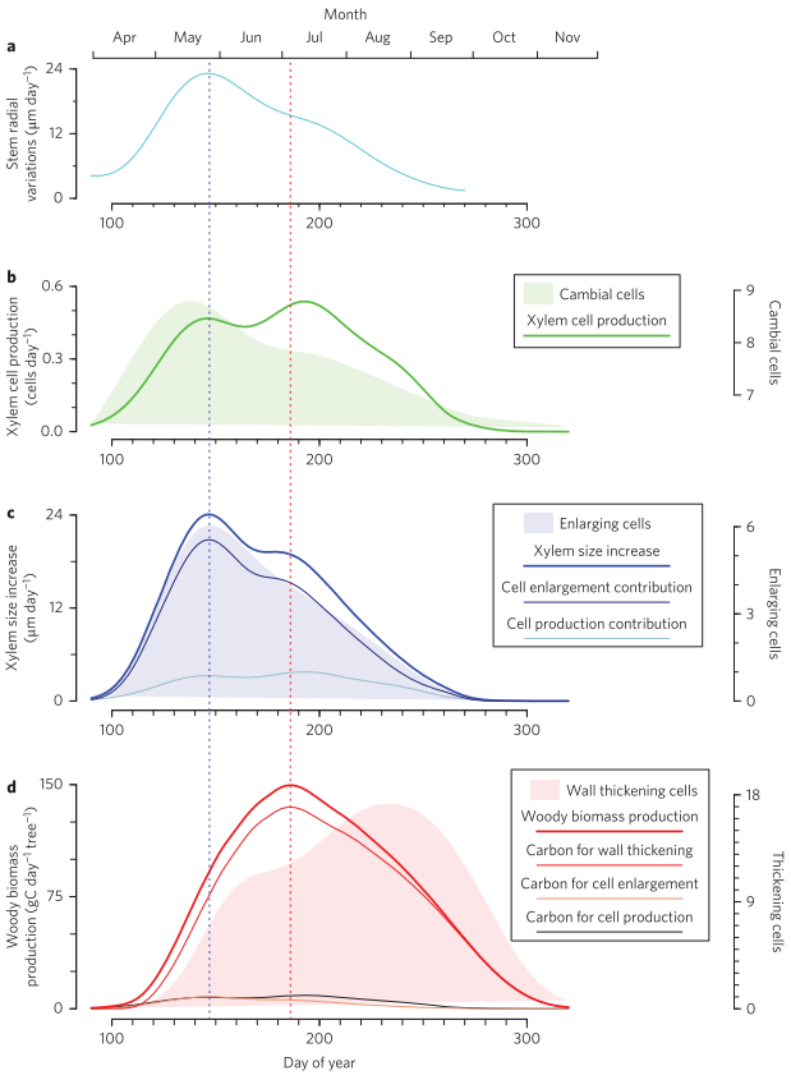


Modified from Cuny 2015

Real-time intra-annual monitoring : Xylogenesis

Steps:

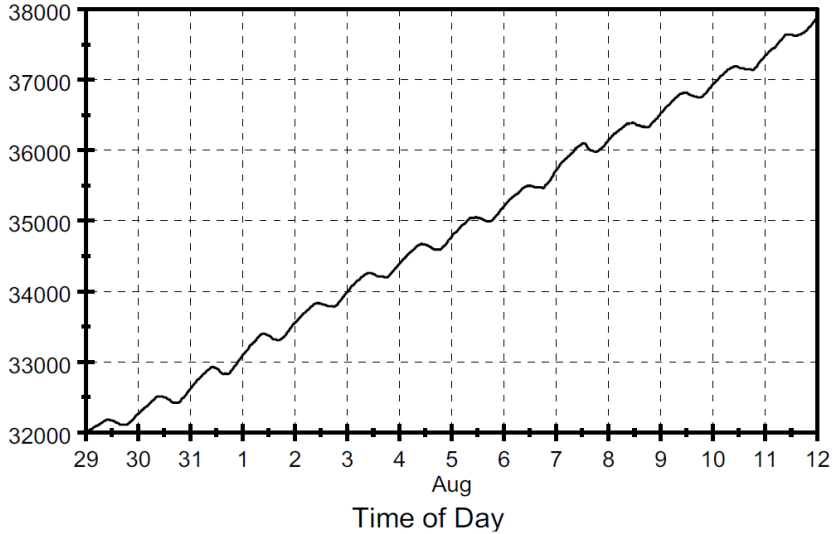
5. Development of time series of the number of cells in each phase



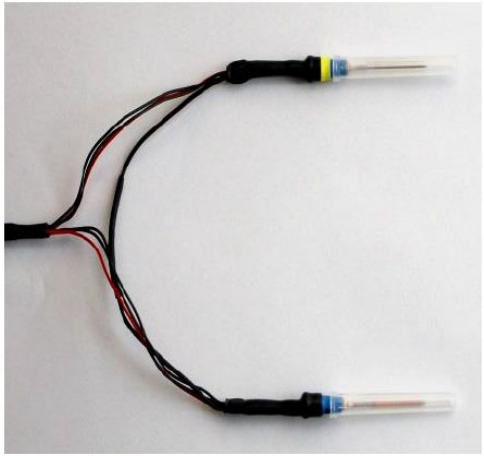
Cuny, H. E., Rathgeber, C. B. K., Frank, D., Fonti, P., Makinen, H., Prislan, P., … Fournier, M. (2015). Woody biomass production lags stem-girth increase by over one month in coniferous forests. *Nature Plants*, *1*, 1–6. doi: 10.1038/nplants.2015.160

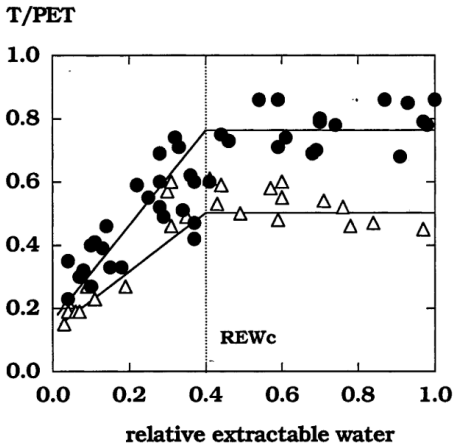
Real-time intra-annual monitoring : Dendrometers

Data is sent every half hour to a data logger and we can then analyze the daily and seasonal variability of the contractions and expansions of the trunk



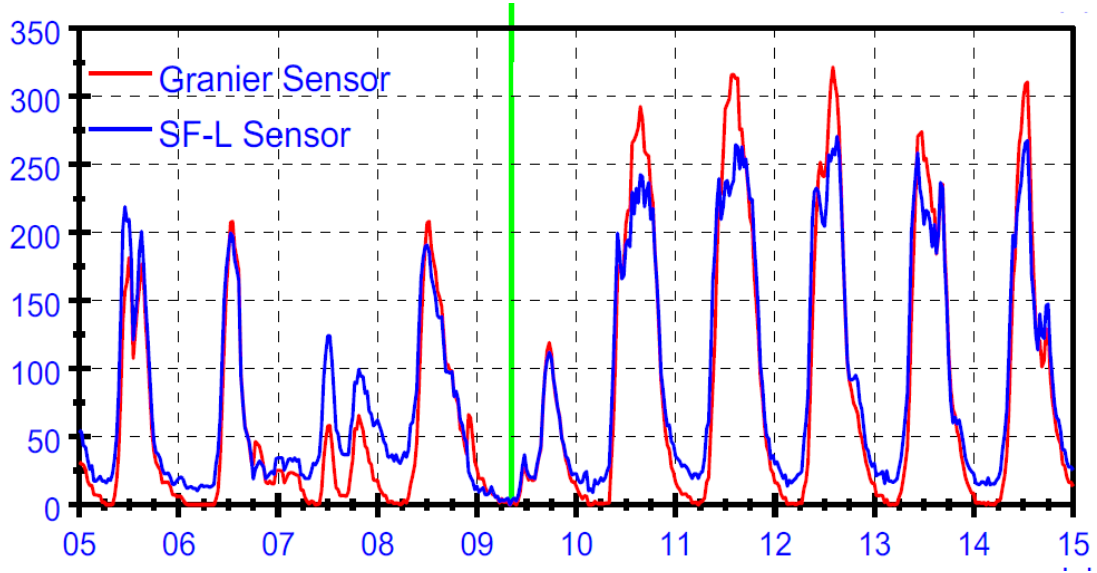
Real-time intra-annual monitoring : sap flow





To analyze the daily and seasonal variability of water movements in the trunk

e.g. We can study how the amount of water in the soil influences transpiration



Granier, A., Bréda, N., Biron, P., & Villette, S. (1999). A lumped water balance model to evaluate duration and intensity of drought constraints in forest stands. *Ecological Modelling*, *116*(2), 269–283. doi: https://doi.org/10.1016/S0304-3800(98)00205-1