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1. IoT Applications
2. TreeTalker
3. Sap Flow
4. Sapwood Water Storage



How many trees do we have?

3.040.000.000.000

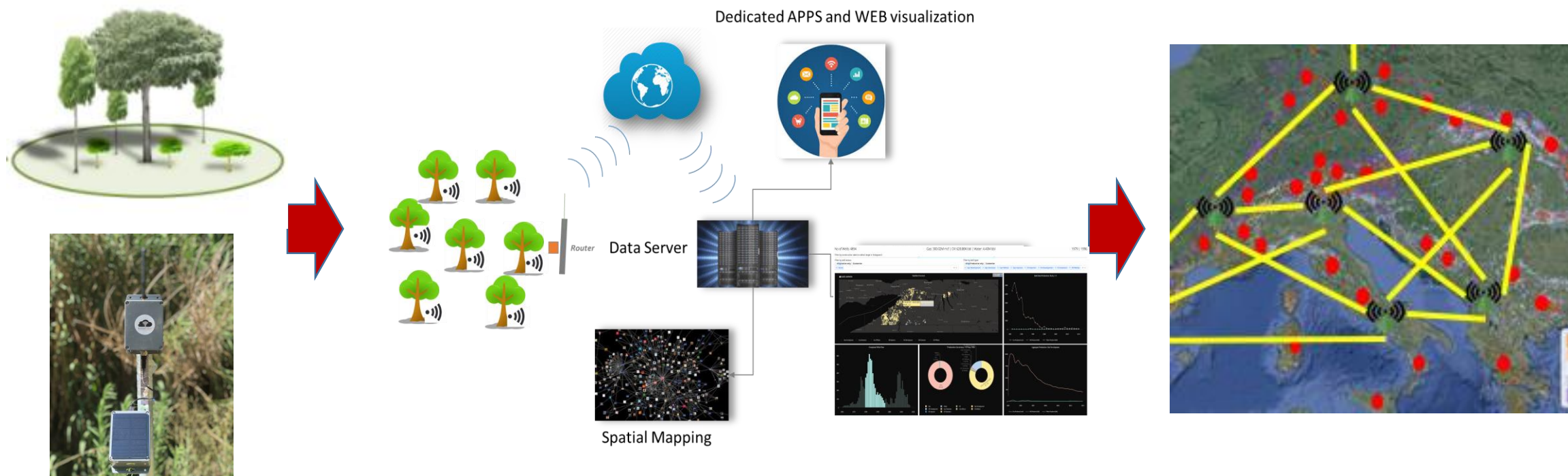
Can we monitor all of the trees?

'Maybe yes'

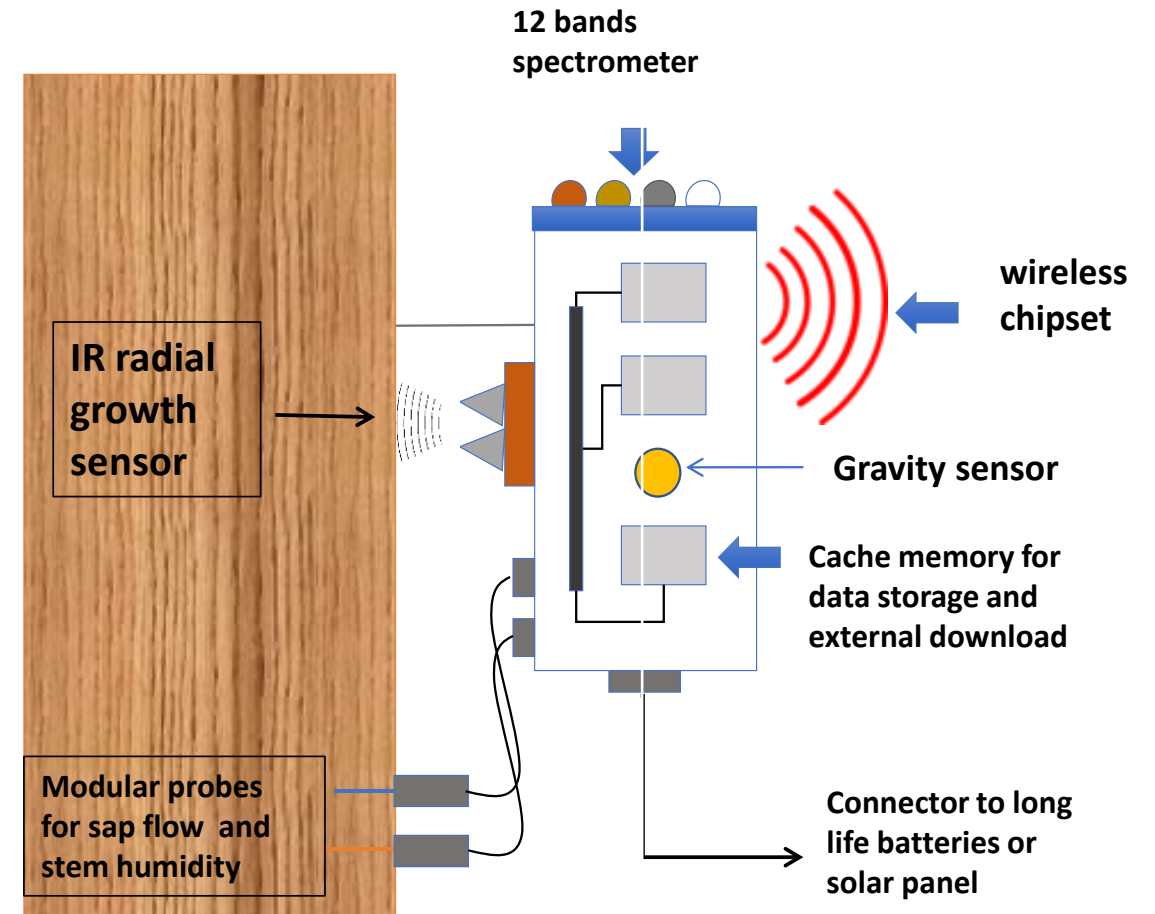
IoT applications: from Industry 4.0 to Nature 4.0



Tree-Talker IoT based network



- 1) Tree radial growth
- 2) Sap flow
- 3) Stem water content
- 4) Light penetration in the canopy
- 5) Foliage dieback and physiology
- 6) Tree stability
- 7) *Micro climate data*
- 8) *Soil moisture content*

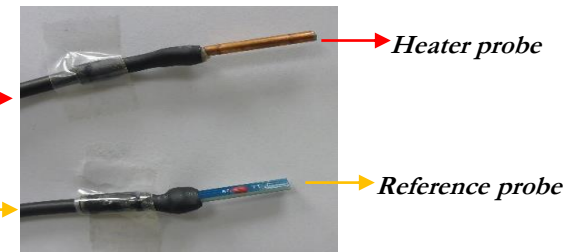
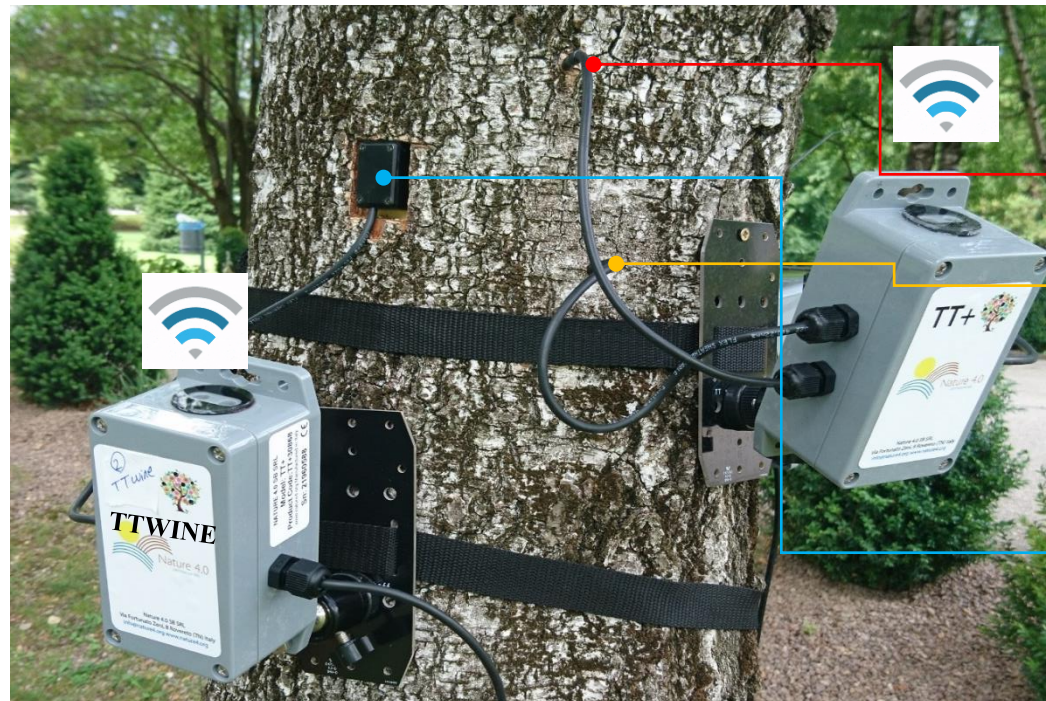


TreeTalker Design: Different Approaches on Sap Flow

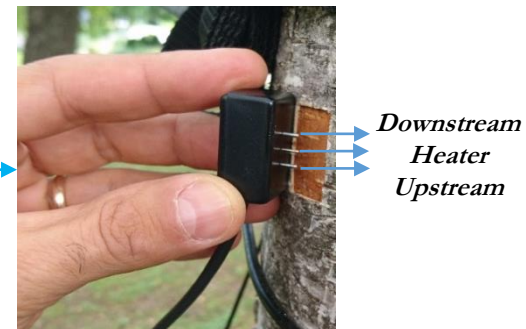


Thermal Dissipation Probe (TDP)
Transient thermal dissipation (TTD)

Heat-Pulse Method (HPV)



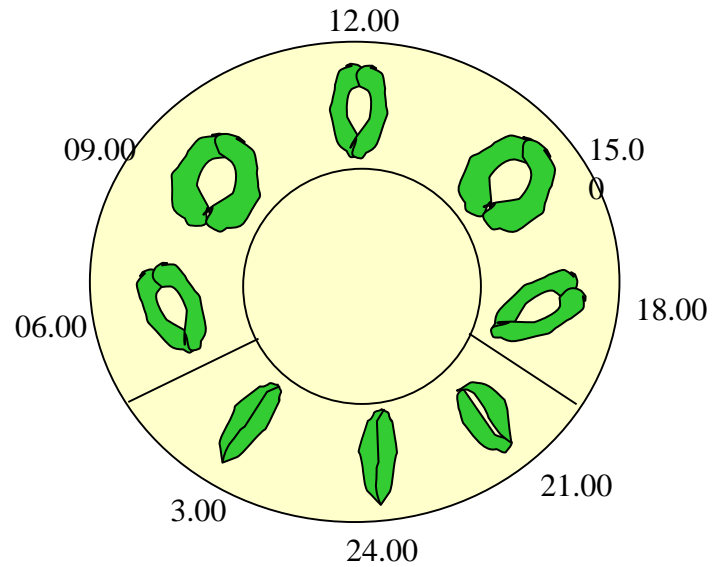
TDP & TTD



HPV

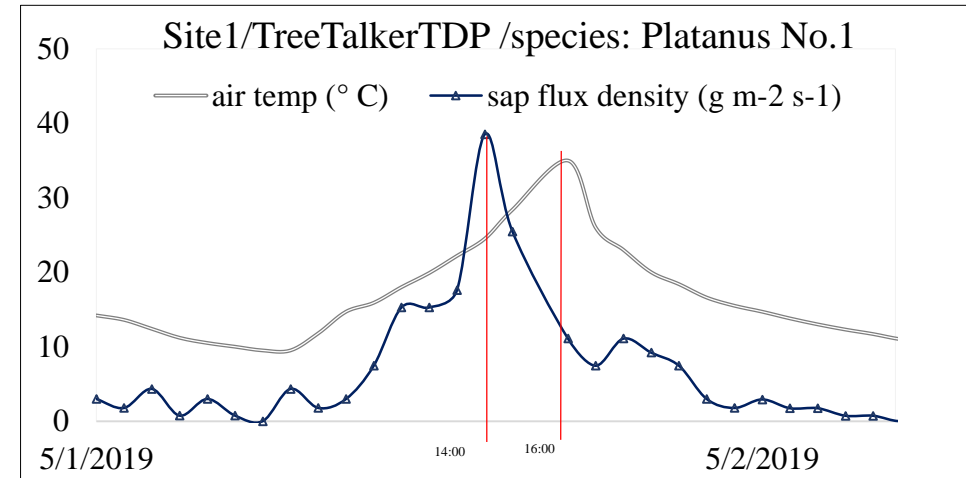
24h Cycle of Stomatal Opening and Closing

Control of transpiration

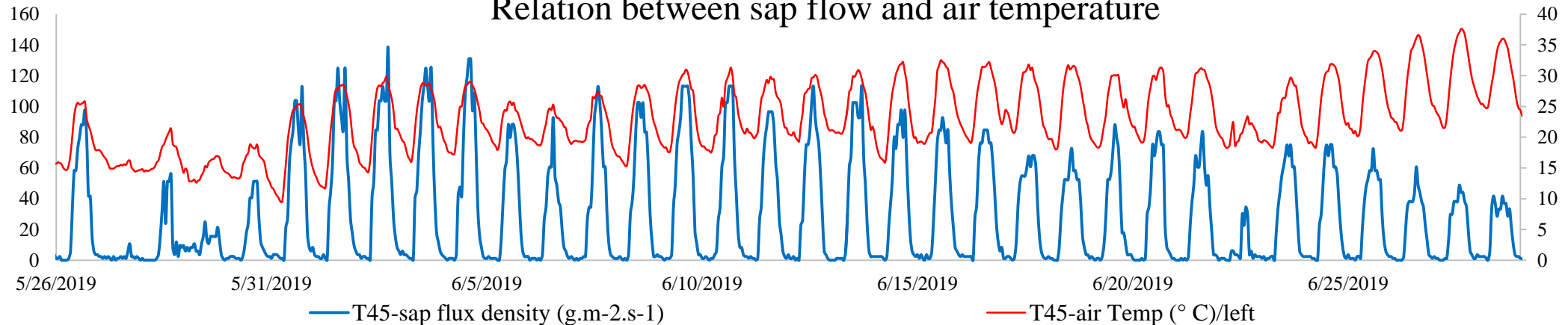


How are your trees coping with the midday extreme temperature?

Max daily sap flow happens before max daily temp

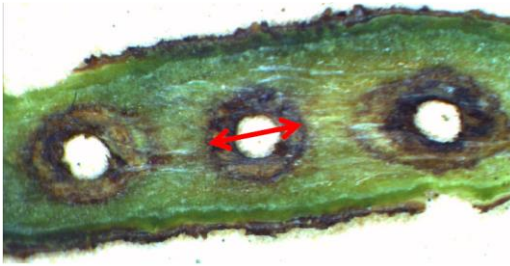


Relation between sap flow and air temperature

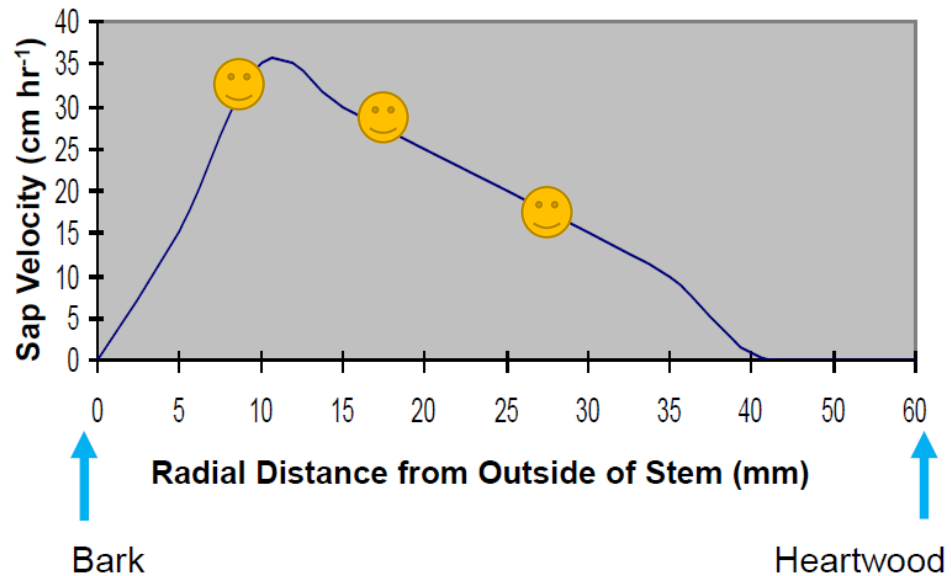


- Anisotropic & Heterogeneous

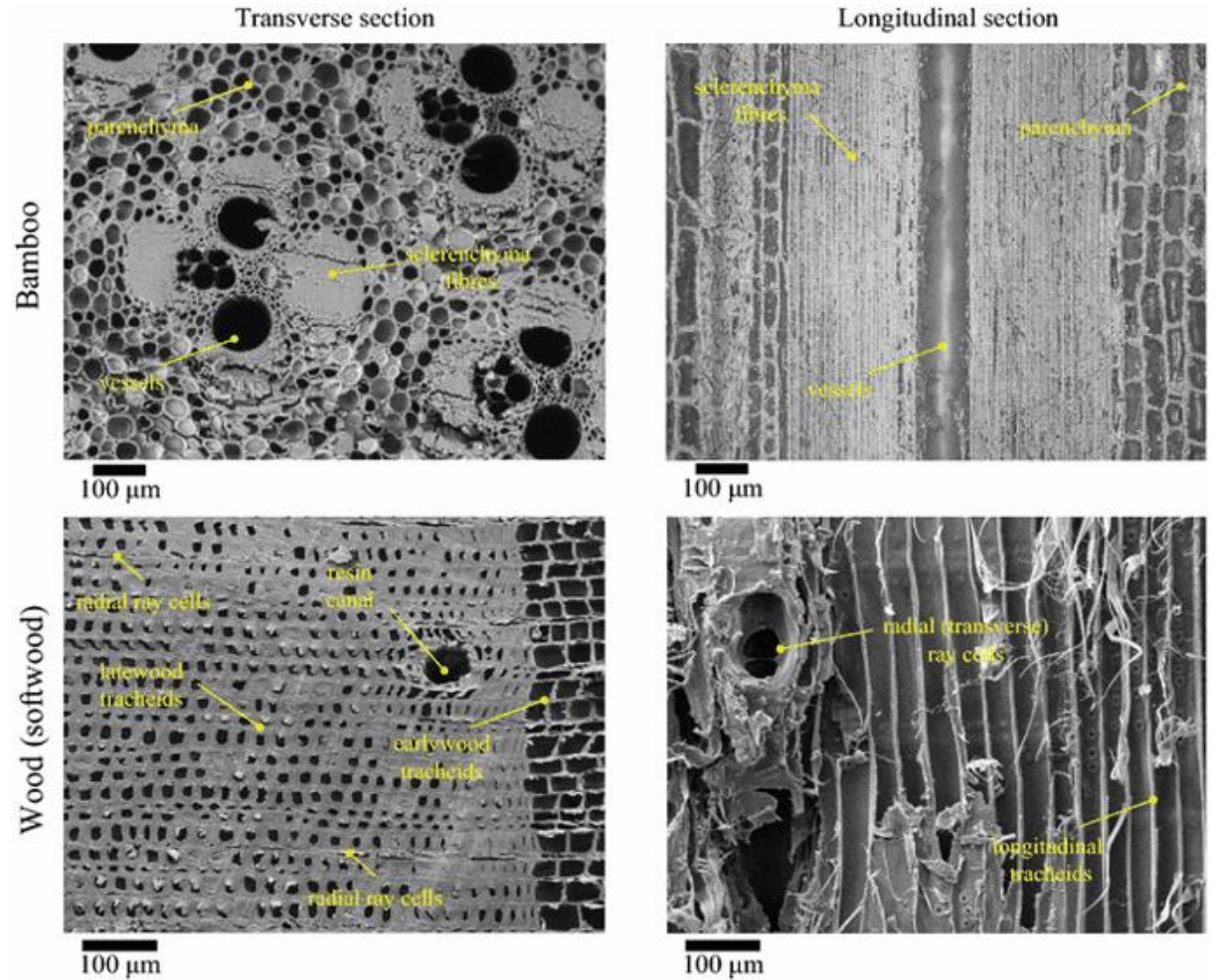
- Wound response



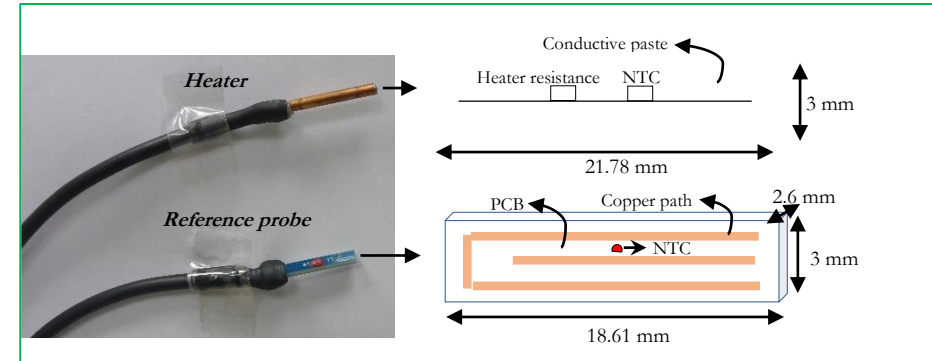
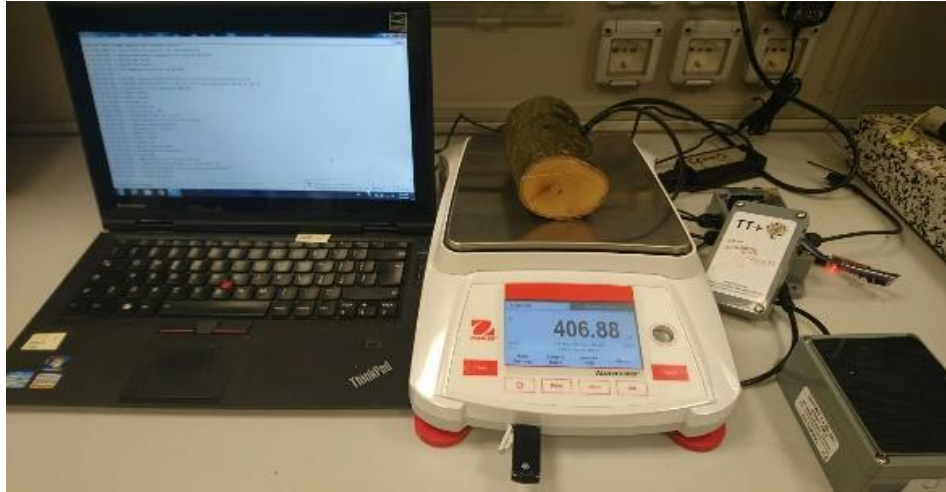
- Radial profile



Note: demonstration data only

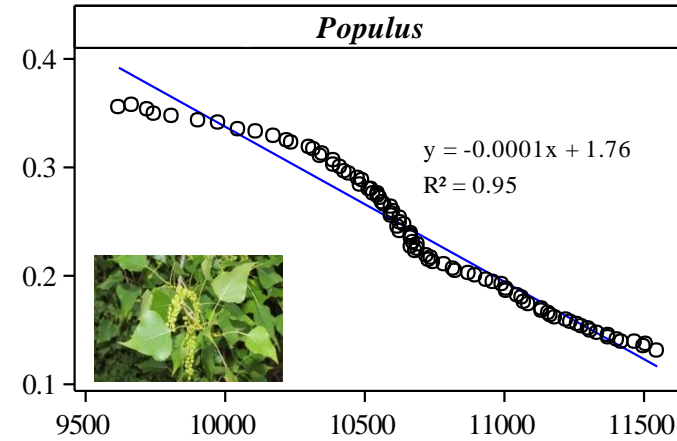
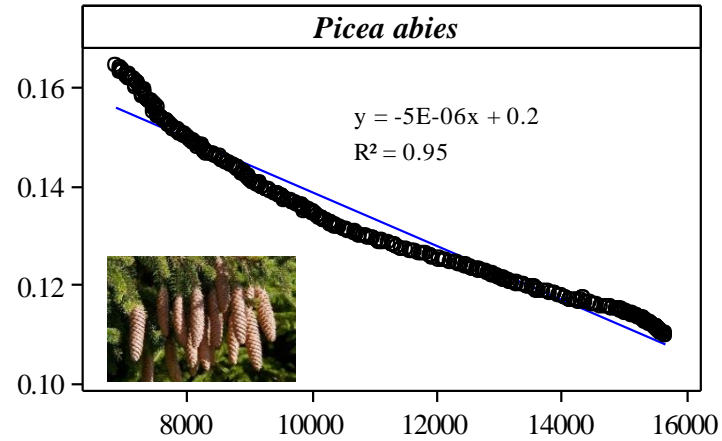
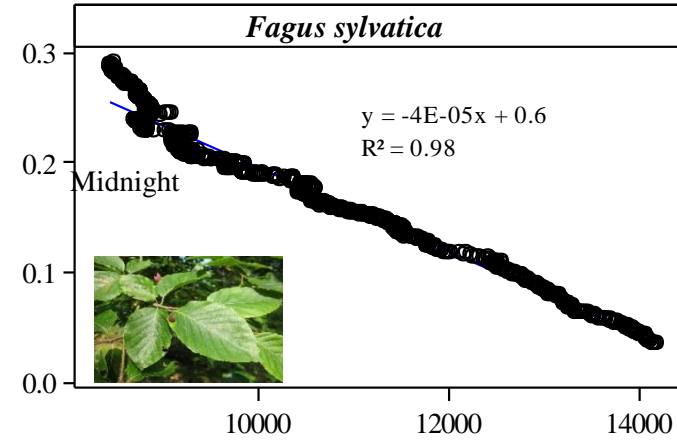
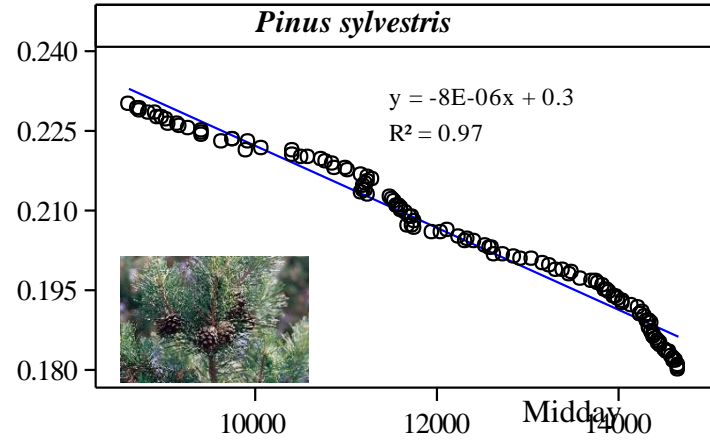


Sapwood Water Storage



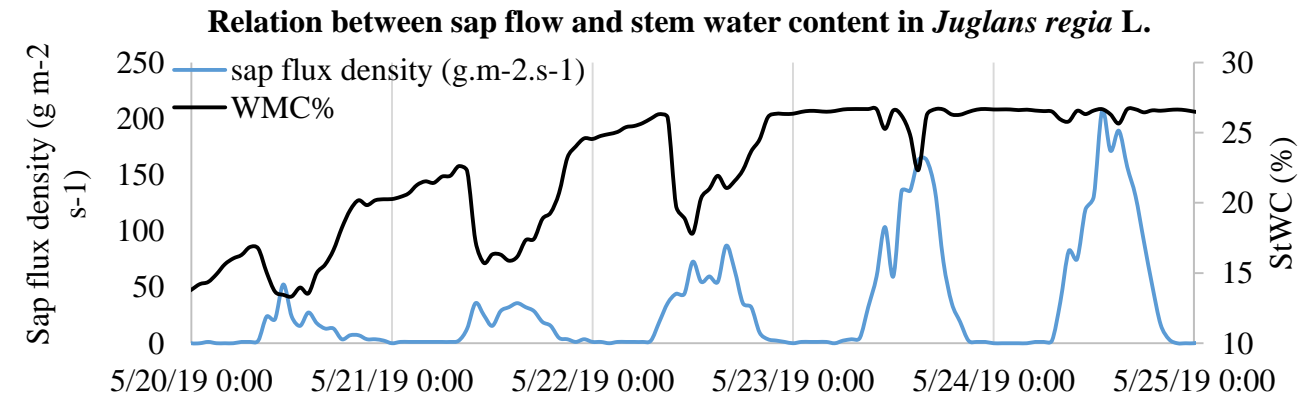
- Frequency-domain capacitance sensor

y-axis: stem volumetric water content (g/cm³) x-axis: frequency (Hz)



← Capacitance sensor/
Calibration equation in Lab

Field experiment in
broadleaf trees



Thank you for your attention

