Where do the buds get their water from during budburst? New perspectives from temperate forest species using water stable isotopes



Paula Martín-Gómez, Jérôme Ogée, Régis Burlett, AdriàBarbeta, Nicolas Devert, Sabrina Dubois, Bastien Frejaville& Lisa WingateE-mail: paulamartingomez@gmail.com



Context



WINTER DORMANCY

Buds are **isolated** from the stem xylem conduits (callose barrier)

New vascular connections

BUD BREAK



When is the exact timing when these new vascular connections are made
What is the origin of the water supporting bud growth and break



We have developed a new method (Barbeta et al. 2020) to partition stem water into:

Vessel water: directly associated to the transpiration stream
Tissue water: associated to the wood matrix

Cryogenic distillation



Centrifugation in CAVITRON



Extraction curves with Cavitron: Pivovaroff 2016 (AoB plant), Cochard 2002. PC&E

Research objectives



1. To assess the timing when buds and stem xylem are **hydraulically connected**

2. To characterize the **source of water** entering budburst: Vessel/tissue water



3. To test our **new method** to partition bulk xylem water into vessel and tissue water to characterize plant phenological changes in water source by using water stable isotopes

Methods: sampling campaigns in the forest during budburst season

Ciron Valley (NW France)

Seasonal sampling of water sources, stems, buds and leaves

Fagus sylvatica Quercus robur Pinus pinaster

+ track of tree phenology (budburst)





Methods: Stem water pool separation and isotope analysis

Complete description in Barbeta et al. 2020

Centrifuge rotor flow + cryogenic distillation method

Vessel and tracheid water: Released by cavitation ~ associated to TRANSPIRATION δ^2 H, δ^{18} O Exchange Bulk water: cryogenic distillation All the water in stems: vessel + tissue

Tissue water:

Parenchyma living cells Fibers cell walls

> ~ associated to WATER STORAGE

> > Gravimentric water content

Photo: Vessels, radial parenchyma and wood fibers in Fagus sylvatica. Prislan et al. 2013. Agric. For. Meteorol.

Results: Stem water pools during budburst for Fagus sylvatica



Results: Xylem/leaf water isotopic compositions for deciduous species



Results: Seasonal evolution of water isotopic compositions in Q. robur



Results: Stem water pools during budburst for *Pinus pinaster*



Conclusions



BEFORE BUDBURST



- Buds are isolated from vessels on stems
- Tissue water decreases during bud swelling
- Bud water ~ bulk water

AFTER BUDBURST



- New vascular connections when leaves are flushed
- Tissue water is replenished
- Leaf water ~ vessel water

Aknowledgements



Barbeta, A., Burlett, R., Martín-Gómez, P., Fréjaville, B., Devert, N., Wingate, L., Domec, J.-C., et al. (2020). Evidence for distinct isotopic composition of sap and tissue water in tree stems: Consequences for plant water source identification. BioRxiv, 2020.06.18.160002.