MEASURING TREE WATER CONTENT AND LOCATING CONDUCTIVE TISSUES WITH PORTABLE MRI

S Blystone, Guilhem Pagès, H Cochard, P Conchon

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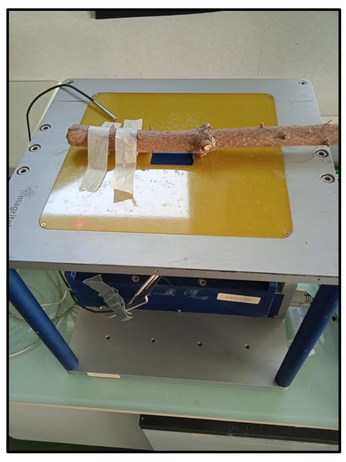
Blystone, Shannan‡†, Pagès, Guilhem‡, Cochard, Hervé†, Conchon, Pierre†
‡INRAE, QuaPA, F-63122 St Genes Champanelle, France
‡INRAE, PROBE research infrastructure, AgroResonance facility, F-63122 St Genes Champanelle, France
†Université Clermont Auvergne, INRAE, PIAF, 63000 Clermont-Ferrand, France

We evaluated the capacities of a portable, unilateral magnet having the potential to evaluate tree water dynamics *in-situ*: The Nuclear Magnetic Resonance Mobile Universal Surface Explorer (NMR-MOUSE). We tested the capacity of this device to measure tree water content in the laboratory, and to sense water peaks which could be correlated to anatomical features.

Materials and Methods

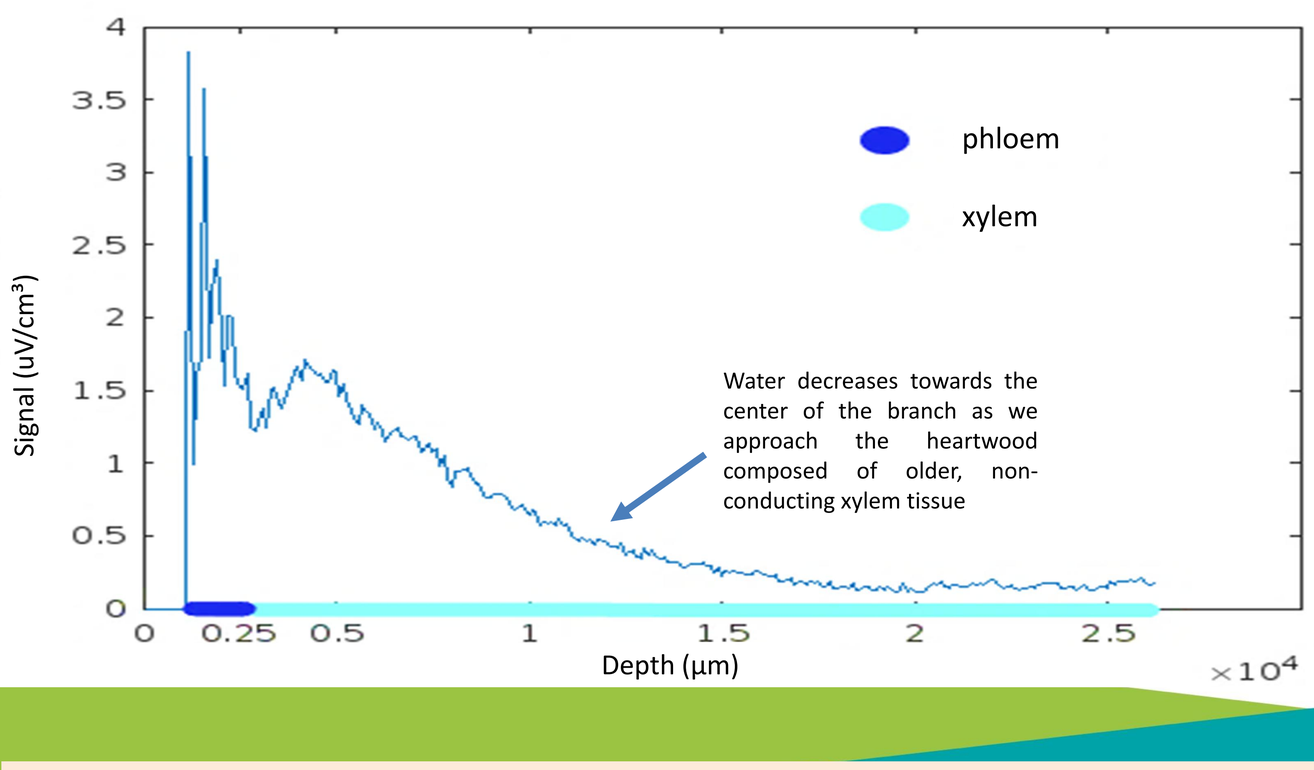
- Thirty branches were cut, consisting of six tree species.
- Using the NMR-MOUSE, branches were measured immediately after sampling, and subsequently measured again, over time, to follow their dehydration dynamic.
- The water content of each branch was calculated by taking its fresh weight before each MRI measurement, and dry weight at the end of all experiments.
- A GLMM model was constructed to test for linear correlations between water content, species and the signal.
- Branches were imaged using x-ray microtomography in order to locate anatomical structures and to correlate them with water peaks on normalized MRI profiles.



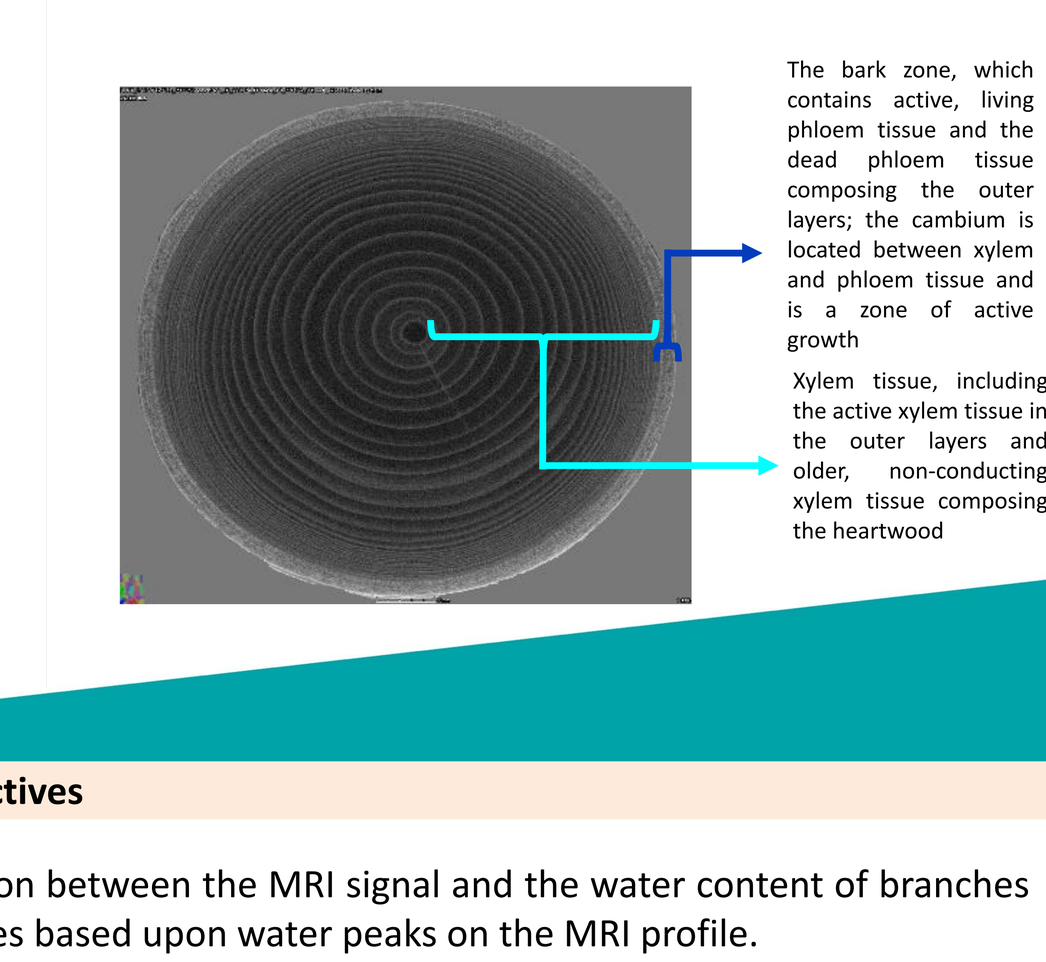
Results

There was a linear correlation between the integral of the MRI profiles and the water content of the branches. This correlation was present regardless of tree species :

All data points



Data points classified by species



The normalized MRI profile of a fir branch (*A. alba*) presented distinct water peaks which corresponded to the xylem and phloem tissues, whose location was validated with x-ray microtomography imaging:

The bark zone, which contains active, living phloem tissue and the dead phloem tissue composing the outer layers; the cambium is located between xylem and phloem tissue and is a zone of active growth

Xylem tissue, including the active xylem tissue in the outer layers and older, non-conducting xylem tissue composing the heartwood

Conclusions and Perspectives

- We were able to observe a highly significant linear correlation between the MRI signal and the water content of branches at the level of the species, as well as locate conductive tissues based upon water peaks on the MRI profile.
- The NMR-MOUSE is a promising candidate for measuring plant water dynamics in the field. Future work will test the capacity of this device to measure tree water content *in-situ*, and to measure the speed of both the xylem and phloem fluxes.

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