Transportable MRI to characterize water in plants directly in their natural environment

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Abstract

Grasslands and forests mitigate global warming due to their high capacity to store carbon. Sap flows play a critical role by supplying water and mineral salts used for transpiration and photosynthesis (xylem) and transporting photosynthetic carbons (phloem) to carbon sinks (e.g., wood, roots, soil). In the context of global warming, a fine understanding of these transport mechanisms is necessary. However, a sensor able to locally probe water content and its movement directly on plants and in their natural environment (i.e., *in situ*) does not yet exist.

To measure water properties non-invasively and in a given spatial volume, MRI is the analytical tool of choice. However, such instruments cannot be moved and only laboratory experiments can be performed. Recently, portable MRI instruments have been developed. To be able to move the MRI system, the magnetic field intensity is significantly decreased. Due to the necessity for innovative design and methods, few portable sensors can record the MRI signal in a slice with a thickness of a few dozen micrometers. Our study is based on one of these sensors, the unilateral NMR-MOUSE, customized with a home-designed vector to place the MRI device against the object to be studied.

Our objective is then to evaluate the capacity of this MRI sensor to measure water, both its repartition and flow, in plants, in their natural environment. In this presentation, I will show (i) the technical challenges we had to overcome to perform measurements outside, and (ii) the interest of this sensor to monitor water status in living systems, and demonstrate its interest as a new sensor in the ecophysiological sciences.