

EGU26-6379, updated on 09 Jul 2026

<https://doi.org/10.5194/egusphere-egu26-6379>

EGU General Assembly 2026

© Author(s) 2026. This work is distributed under the Creative Commons Attribution 4.0 License.



From Rhizotron Experiments to Functional-Structural Models: Quantifying Root Plasticity Under Soil Water Heterogeneity

Erfan Nouri, Xavier Draye, and Mathieu Javaux

UCLouvain, Earth and Life Institute (ELI-e), Bioengineering, Belgium (erfan.nouri@uclouvain.be)

From Rhizotron Experiments to Functional-Structural Models: Quantifying Root Plasticity Under Soil Water Heterogeneity

Erfan Nouri, Xavier Draye, Mathieu Javaux

Abstract

Understanding root water uptake under heterogeneous soil moisture conditions is a central objective of this PhD, which aims to improve the mechanistic representation of root-soil interactions under climate-driven drought. Achieving this requires accurate, spatially resolved information on soil water availability at the scales experienced by individual roots rather than whole root systems. However, experimental approaches capable of quantifying soil moisture heterogeneity non-destructively and under controlled hydraulic conditions remain limited.

Within the HYDRA-MAIZE project, we developed a compartmentalized rhizotron platform designed to monitor root growth and soil moisture simultaneously under controlled soil water potential patterns. The system imposes stable, user-defined soil water potentials across hydraulically isolated compartments while enabling optical measurements of soil moisture via light-transmission imaging.

We established a calibration framework that combines image-based light-transmission measurements with independent determination of soil water retention. Normalized light intensity is used to account for structural heterogeneity unrelated to water content, enabling assessment of relationships between transmitted light, volumetric water content, and imposed suction. This provides a basis for evaluating theoretical and empirical formulations linking optical signals to soil moisture state.

The platform further enables quantification of spatial resolution and uncertainty in light-transmission-based water content estimation, both horizontally and vertically within rhizotron compartments. By resolving soil water availability at scales relevant to individual root segments, this setup will allow linking local and systemic morphological and hydraulic responses to soil water heterogeneity at high spatial and temporal resolution without disturbing the plant or substrate. The platform will also support coupling rhizotron data with functional-structural plant models (FSPM) for quantitative analyses of root-soil interactions.