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Isotope labeling experiment to infer ecohydrological travel times

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Stable water isotopes are promising tracers to study soil-tree interactions and root water uptake. Traditionally, destructive sampling techniques are applied to measure the isotopic signature in soils and plant tissues but these methods are limited in their temporal resolution. For calculating ecohydrological travel times from soil water to transpiration, high frequent isotope measurements are required. Recently, in-situ water isotope probes have been successfully applied in beech trees to yield high-frequent isotope measurements under field conditions but the complexity and heterogeneity of natural field conditions can make a systematical method testing difficult. Here, we test whether the new probes are capable of capturing tree species-specific differences in root water uptake and associated travel times.

We test this in a controlled experiment using large pots with three 4-6 meter high and 20 year old coniferous and deciduous trees: *Pinus pinea*, *Alnus x spaethii* and *Quercus suber* that are expected to have different water uptake strategies. We applied deuterated irrigation water to the homogeneous soils in the pots and traced the water flux from the soils through the trees with in-situ isotope probes in high temporal resolution.

This contribution presents preliminary results on ecohydrological travel times in relation to environmental parameters such as sap flow, photosynthetic activity, matrix potential, soil water content, water vapor pressure deficit and solar radiation.

Our in-situ isotope probes were capable to capture the breakthrough of the isotope tracer in all trees. The calculated travel times were shorter for the Pinus and Alnus compared to the Quercus which suggests differences in root water uptake. Detailed results from such controlled experiments are fundamental for testing new measurement techniques such as the in-situ isotope probes. Such results are important to better interpret results measured under natural and therefore more complex and heterogeneous field conditions.