Water ages at the soil root interface and beyond

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At the catchment scale, incoming precipitation is typically partitioned into runoff and evapotranspiration. Most transit time modeling approaches focus on the runoff part of the water balance and are consequently evaluated with respect to water ages in streamflow. Nevertheless, most modeling approaches also include a more or less detailed representation of evapotranspiration. In order to evaluate whether a modeling approach appropriately captures evapotranspiration and its water ages, it is important to understand what processes are required to be considered in the models. While evaporation from the soil and canopy surfaces is relatively easy to observe, transpiration involves root water uptake from a range of depths below the soil surface and water transport within plants. In addition, experimental data to evaluate transit time models are sampled in different organs and locations of plants.

We will present the results of studies dealing with the transit times of root water uptake (between precipitation and water uptake) and with transit times internally in trees (between water uptake at the root tips and transpiration at the leaves) in temperate forests. A novel in-situ measurement technique enabled us to measure stable water isotopes in the soil and within tree stem xylem with unprecedented temporal resolution and thereby enabled us to refine our understanding of plant water uptake and tree internal water transport. Based on our experimental observations, we developed a new approach to model water transport and hence water transit time internally in trees.