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Publication

Employing stable isotopes to determine the residence times of soil water and the temporal origin of water taken up by *Fagus sylvatica* and *Picea abies* in a temperate forest

JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

ID 4480505

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Year 2018

Title Employing stable isotopes to determine the residence times of soil water and the temporal origin of water taken up by *Fagus sylvatica* and *Picea abies* in a temperate forest

Journal The New phytologist

Volume 219

Number 4

Pages / Article-Number 1300-1313

Mesh terms Deuterium; *Fagus*, physiology; Forests; Isotope Labeling; Oxygen Isotopes; *Picea*, physiology; Plant Roots, metabolism; Rain; Regression Analysis; Soil, chemistry; Time Factors; Water, metabolism; Xylem, physiology

We assessed how the seasonal variability of precipitation δ ; 2; H and δ ; 18; O is propagated into soil and xylem waters of temperate trees, applied a hydrological model to estimate the residence time distribution of precipitation in the soil, and identified the temporal origin of water taken up by *Picea abies* and *Fagus sylvatica* over 4äyr. Residence times of precipitation in the soil varied between a few days and several months and increased with soil depth. On average, 50% of water consumed by trees throughout a year had precipitated during the growing season, while 40% had precipitated in the preceding winter or even earlier. Importantly, we detected subtle differences with respect to the temporal origin of water used by the two species. We conclude that both current precipitation and winter precipitation are important for the water supply of temperate trees and that winter precipitation could buffer negative impacts of spring or summer droughts. Our study additionally provides the means to obtain realistic estimates of source water δ ; 2; H and δ ; 18; O values for trees from precipitation isotope data, which is essential for improving model-based interpretations of δ ; 18; O and δ ; 2; H values in plants.

Publisher WILEY

ISSN/ISBN 1469-8137

edoc-URL <https://edoc.unibas.ch/64632/>

Full Text on edoc No;

Digital Object Identifier DOI 10.1111/nph.15255

PubMed ID <http://www.ncbi.nlm.nih.gov/pubmed/29888480>

ISI-Number WOS:000440847600018

Document type (ISI) Journal Article