

Publication

The O-18-signal transfer from water vapour to leaf water and assimilates varies among plant species and growth forms

JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

ID 4601932

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Year 2020

Title The O-18-signal transfer from water vapour to leaf water and assimilates varies among plant species and growth forms

Journal PLANT CELL AND ENVIRONMENT

Volume 43

Number 2

Pages / Article-Number 510-523

Keywords carbohydrates; clouds; compound-specific isotope analysis (CSIA); fog; foliar water uptake; leaf wetting; precipitation; rain

Mesh terms Science & TechnologyLife Sciences & BiomedicinePlant SciencesPlant Sciences

The O-18 signature of atmospheric water vapour ($\delta O-18(V)$) is known to be transferred via leaf water to assimilates. It remains, however, unclear how the O-18-signal transfer differs among plant species and growth forms. We performed a 9-hr greenhouse fog experiment (relative humidity $\geq 98\%$) with O-18-depleted water vapour (-106.7 parts per thousand) on 140 plant species of eight different growth forms during daytime. We quantified the O-18-signal transfer by calculating the mean residence time of O in leaf water (MRTLW) and sugars (MRTSugars) and related it to leaf traits and physiological drivers. MRTLW increased with leaf succulence and thickness, varying between 1.4 and 10.8 hr. MRTSugars was shorter in C-3 and C-4 plants than in crassulacean acid metabolism (CAM) plants and highly variable among species and growth forms; MRTSugars was shortest for grasses and aquatic plants, intermediate for broadleaf trees, shrubs, and herbs, and longest for conifers, epiphytes, and succulents. Sucrose was more sensitive to $\delta O-18(V)$ variations than other assimilates. Our comprehensive study shows that plant species and growth forms vary strongly in their sensitivity to $\delta O-18(V)$ variations, which is important for the interpretation of $\delta O-18$ values in plant organic material and compounds and thus for the reconstruction of climatic conditions and plant functional responses.

Publisher WILEY

ISSN/ISBN 0140-7791

edoc-URL <https://edoc.unibas.ch/78130/>

Full Text on edoc No;

Digital Object Identifier DOI 10.1111/pce.13682

PubMed ID <http://www.ncbi.nlm.nih.gov/pubmed/31732962>

ISI-Number 000500151900001

Document type (ISI) Article