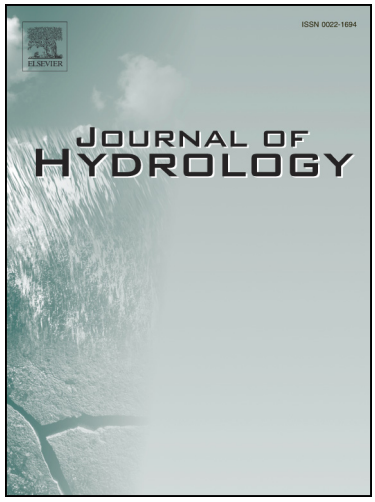

Research papers

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PII: S0022-1694(18)30630-9
DOI: https://doi.org/10.1016/j.jhydrol.2018.08.033
Reference: HYDROL 23047

To appear in: *Journal of Hydrology*

Received Date: 11 May 2018
Revised Date: 10 August 2018
Accepted Date: 15 August 2018

Please cite this article as: Ding, Y., Nie, Y., Schwinning, S., Chen, H., Yang, J., Zhang, W., Wang, K., A Novel Approach for Estimating Groundwater Use by Plants in Rock-dominated Habitats, *Journal of Hydrology* (2018), doi: https://doi.org/10.1016/j.jhydrol.2018.08.033

A Novel Approach for Estimating Groundwater Use by Plants in Rock-dominated Habitats

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Abstract

Plant water use is an important component in the function of Earth's critical zone and this can be examined by decomposing isotope composition of xylem water into contributions from precipitation stored in shallow soil layers and deeper groundwater. The usual procedure for estimating the proportional use of groundwater by plants is to sample the isotope composition of soil and groundwater and determine the most probable mixing coefficients from all potential sources. Here we propose and test a novel method for achieving the same goal without sampling soil water. The method is based on analyzing variability in the stem water isotope ratios of several members of a community and the known isotope ratio of groundwater to 'triangulate' the unknown isotope ratio of stored rainwater. Using a simple water balance model, parameterized to produce the best fit between actual and estimated stem water isotope ratios, we simulated seasonal variation in the volume and isotope ratio of rainwater storage, along with species-specific groundwater use ratios. The method was applied to eight woody plant species growing on two rocky outcrops in the South China karst. Estimated average proportional groundwater use over two seasons varied between 14% and 62% and was site-dependent. For the majority of species, groundwater use increased as estimated stored rainwater volume declined. The two species with highest groundwater use were taller,