Biogeosciences Discussions

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# Reply on RC1

Aaron Smith et al.

Author comment on "Modelling temporal variability of in situ soil water and vegetation isotopes reveals ecohydrological couplings in a riparian willow plot" by Aaron Smith et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-278-AC1, 2021

The authors thank the reviewer for their constructive comments on the manuscript. Our reply here is intended to clarify key issues identified by the reviewer, and we will conduct a point-by-point response to all comments at a later date.

One of the primary concerns that the reviewer has raised with the distance-based approach is the linkage with EcH2O-iso functionality and set-up. The reviewer is corrected that the standard version of EcH2O (and EcH2O-iso) results in vegetation water originating only from the same cell. The authors had tried to indicate that this structure had been modified for the application at this study site as this structure was deemed to be a limiting factor here due to insufficient water to maintain transpiration within the willow cells. It was for this reason that the aspect ratio of roots was introduced to directly estimate the proportion of roots (and water uptake) inside and outside (neighbouring) the cell. The isotopic composition in xylem (and age) is thereby a mixture of current and surrounding cell isotopic composition. The authors can revise Figure 6 to better indicate that soil water sources indicated are a combination of the current and surrounding cells. The distance-based mixing does not only encompass a “lag-based” component but also encompasses the mixing of different water pools, amounts, and temporal periods. From this perspective, the authors believe that the approach presented accounts for fine spatial scale patterns.

The root-stem mixing utilized in this manuscript was not part of the EcH2O code; rather, utilizing outputs from EcH2O-iso to drive the mixing as described in the manuscript. This includes the proportion of water use from different cells and at different soil depths. The approach here differs from the approach as defined in Knighton et al. (2020) in that mixing described here utilizes the rooting distribution and distances to physically describe mixing. While lateral contributions (outside the cell) will diminish with a coarser model scale, this approach maintains the mixing of different temporal water pools within the cell defined by the vertical (Kroot) and horizontal (aspect) root distribution.

The authors explicitly chose to include the AIC as a means to test the significance of the added parameters required by the distance-based approach as efficiency criteria do not present this significance, and visual inspection may be skewed due to the relatively short transit time. Visually, differences are more difficult to identify given that the exponential profiles of roots produced a distribution of transit times with a long tail (i.e. older water uptaken by vegetation). While the AIC may be close, the difference is significant, where smaller values show substantial improvement in performance. Given that AIC utilized loglikelihood functions for evaluation, it is unsurprising that there may be some differences between the outcome of AIC and KGE. Furthermore, while there is the appearance that the distance-based mixing is outperformed by the instant mixing when the measured isotopic values are utilized, it is important to recognize that mixing utilizes calibrated root distributions. These distributions are estimated as part of the optimisation of the whole EcH2O-iso model and are not optimised for uptake proportions when more enriched soil isotopes are utilized.

The authors are confident that the above clarifications to the manuscript as well as other revisions suggested by the specific comments would result in a clear presentation of the approach used by the study, the model set up and the significance of the findings.