The multifaceted relationship between leaf water 18 O enrichment and transpiration rate

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Stable oxygen isotope ratio of leaf water (δ 18 O L) yields valuable information on many aspects of plant–environment interactions. However, current understanding of the mechanistic controls on δ 18 O L does not provide complete characterization of effective path length (L) of the Péclet effect, – a key component of the leaf water model. In this study, we collected diurnal and seasonal series of leaf water enrichment and estimated L in six field-grown angiosperm and gymnosperm tree species. Our results suggest a pivotal role of leaf transpiration rate (E) in driving both within- and across-species variations in L . Our observation of the common presence of an inverse scaling of L with E in the different species therefore cautions against (1) the conventional treatment of L as a species-specific constant in leaf water or cellulose isotope (δ 18 O p) modelling; and (2) the use of δ 18 O p as a proxy for g s or E under low E conditions. Further, we show that incorporation of a multi-species L - E scaling into the leaf water model has the potential to both improve the prediction accuracy and simplify parameterization of the model when compared with the conventional approach. This has important implications for future modelling of oxygen isotope ratios.
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