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Oxygen isotope signatures of transpired water vapor – the role of isotopic non-steady-state transpiration of Mediterranean cork-oaks (Quercus suber L.)under natural conditions

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Oxygen isotope signatures of transpired water vapor (δT) are a powerful tracer of water movement from plants to the global scale, but little is known on short-term variability of δT as direct high-frequency measurements are lacking.
A laser spectrometer was coupled to a gas-exchange chamber directly estimating branch-level fluxes and δT to evaluate a modeling approach and investigate the role of isotopic non-steady-state transpiration under natural conditions in distinct seasons in cork-oaks (Quercus suber L.).
The isotope signature of transpiration (δT) always deviated from steady-state predictions (ΔT) throughout most of the day even when leaf water at the evaporating sites is near isotopic steady-state. Thus, ΔT is further amplified compared to deviations of leaf water isotopes from steady-state, specifically in dry conditions. High agreement was found for direct estimates and modeled ΔT assuming non-steady-state conditions of leaf-water at the evaporating sites.
Strong isoforcing on the atmosphere of transpiration in isotopic non-steady-state imply that short-term variations in δT have likely consequences for large-scale applications, e.g. partitioning of ecosystem evapotranspiration or carbon fluxes using C18O16O, or satellite-based applications.