Do 2H and 18O in leaf water reflect environmental drivers differently?

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Author(s) Cernusak, Lucas A.; Barbeta, Adrià; Bush, Rosemary T.; Eichstaedt Bögelein, Rebekka; Ferrio, Juan Pedro; Flanagan, Lawrence B.; Gessler, Arthur; Martín-Gómez, Paula; Hirl, Regina T.; Kahmen, Ansgar; Keitel, Claudia; Lai, Chun-Ta; Munksgaard, Niels C.; Nelson, Daniel B.; Ogée, Jérôme; Roden, John S.; Schnyder, Hans; Voelker, Steven L.; Wang, Lixin; Stuart-Williams, Hilary; Wingate, Lisa; Yu, Wusheng; Zhao, Liangju; Cuntz, Matthias
Author(s) at UniBasel Kahmen, Ansgar ;
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We compiled hydrogen and oxygen stable isotope compositions (δ2 H and δ18 O) of leaf water from multiple biomes to examine variations with environmental drivers. Leaf water δ2 H was more closely correlated with δ2 H of xylem water or atmospheric vapour, whereas leaf water δ18 O was more closely correlated with air relative humidity. This resulted from the larger proportional range for δ2 H of meteoric waters relative to the extent of leaf water evaporative enrichment compared with δ18 O. We next expressed leaf water as isotopic enrichment above xylem water (Δ2 H and Δ18 O) to remove the impact of xylem water isotopic variation. For Δ2 H, leaf water still correlated with atmospheric vapour, whereas Δ18 O showed no such correlation. This was explained by covariance between air relative humidity and the Δ18 O of atmospheric vapour. This is consistent with a previously observed diurnal correlation between air relative humidity and the deuterium excess of atmospheric vapour across a range of ecosystems. We conclude that 2 H and 18 O in leaf water do indeed reflect the balance of environmental drivers differently; our results have implications for understanding isotopic effects associated with water cycling in terrestrial ecosystems and for inferring environmental change from isotopic biomarkers that act as proxies for leaf water.
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