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Using Deuterium to trace movement and storage of water in Eucalypt trees

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The capacity of trees to release water from storage compartments into the transpiration stream can mitigate damage to hydraulic functioning. However, the location and magnitude of these 'mobile' water sources still remains a topic of research. We conducted an experiment on two tree species that naturally grow in regions of high (Eucalyptus tereticornis) and low (E. sideroxylon) rates of annual precipitation. Deuterium enriched water (1350 ‰ label strength) was introduced into the transpiration stream of three trees per species for four consecutive days. Then the trees were felled and samples of all woody tissues were collected from different heights and positions of the stem. Water was extracted from all samples and the isotopic composition measured. Our results indicate that vertical water transport was more efficient in E. tereticornis while radial water transport was more pronounced in E. sideroxylon. The latter has a larger relative stem water storage capacity than E. tereticornis. This is probably related to differences in the hydraulic architecture across the two species, with a larger resistance of the xylem to cavitation in E. sideroxylon due to smaller vessel diameters, resulting in the trade-off of slower growth and lower tree height. Generally water in the phloem is a larger source for capacitance than water in the heartwood. Further integrative data analyses will improve our understanding of the mechanisms that allow trees to survive and adapt to drought.