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Interactive comment

Interactive comment on "How plant water status drives tree source water partitioning" *by* Magali F. Nehemy et al.

Anonymous Referee #2

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This study explores the role of soil and plant water status, evaporative demand and root distribution on the water use dynamics of two heavily-equipped, willow trees (Salix viminalix) installed in isolation within a buried lysimeter. Plant water deficit (noted ΔW, where ΔW=0 means that maximum daily stem radius has not shrunk since the previous day, and that plant water status is "optimal") is estimated from a micro-dendrometer at stem base. Soil water status is estimated from soil tensiometers at 5 soil depths, evaporative demand and tree transpiration is retrieved from lysimeter and sap flow data, and tree water origin is retrieved from water isotope (2H/1H and 18O/16O) tracing techniques and statistical mixing models, using three potential water sources: top (0-50cm) and deep (50-150cm) bulk soil water, and mobile soil water (extracted at all depths using ceramic cups at 600hPa). The authors identify three distinct periods of

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plant water status (optimal, sub-optimal and transient) and find that, at least during periods when plant water status is sub-optimal ($\Delta W>0$), vertical variations in soil water matric potential, more than root distribution, explains the origin of tree water. Observing as well that soil water potential is the main explanatory variable of variations in ΔW, they conclude: "plant water status drives tree source water partitioning".

First of all, I am not comfortable with the connection made between plant and soil water status. The two are linked of course but the results mostly show that plants take up soil water where it is available. The fact that the water uptake distribution may change between periods of contrasted plant water status is only because the soil water distribution also changes between these three periods.

Now, the idea that plants take up soil water where it is available is not too surprising, especially in trees where fine root length density is relatively high and well distributed across the soil horizons (Figure 7). Theories of soil water uptake by plants can explain this pattern (Cowan, 1965; Javaux et al. 2008). Even when fine root length density is not well distributed, root water uptake will depend mostly on the soil water status. This is because root water uptake increases with the soil-to-root water potential difference and decreases with the hydraulic resistance across the rhizosphere, the root endodermis and along the xylem network. In a drying soil, this network of hydraulic resistances is often dominated by the resistance through the rhizosphere, that depends on fine root density but mostly on soil hydraulic conductivity and thus soil water potential.

Also the three periods identified by the authors are quite arbitrary. They could also correspond to periods of beginning of stem growth ($\Delta W=0$), growth ($\Delta W\geq0$) and no growth ($\Delta W>0$), or little rain but high water content ($\Delta W=0$), more intermittent rain and (deep) soil water deficit ($\Delta W\geq0$) and no rain and higher (top) soil water deficit (until heavy rain comes) ($\Delta W>0$). Ideally we would want to study the relationship between plant water sources and plant (or soil) water status on a more continuous basis, a bit like the relationship found between ΔW and sap flux (I guess mostly a result of an increase in both evaporative demand and functional sapwood area during periods of positive ΔW). Having only one sampling day for each period is a bit limiting to draw definite conclusions about how plant water uptake varies over the season.

Finally, I do not understand how the different potential water sources are treated. The authors consider only three potential water sources: "mobile" (i.e. "extractable" at a suction of 600hPa) soil water at all depths, bulk "shallow" (0-50cm) soil water and bulk "deep" (50-200cm) soil water. But the bulk water includes the mobile water then. How can the authors argue: "shallow and deep [water samplings] represented water pools that were held under tensions below 600hPa"?

In conclusion, I find the experimental work carefully designed and of overall very good quality but the amount of sampling campaign for water isotope analysis is a bit limiting, the interpretation of the results is a bit problematic and the overall conclusions are mostly confirmatory.

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