Biogeosciences Discuss., 9, C2662–C2665, 2012
www.biogeosciences-discuss.net/9/C2662/2012/


**Biogeosciences Discussions**

# *Interactive comment on* "Partitioning of soil water among canopy trees during a soil desiccation period in a temperate mixed forest" *by* M. Meißner et al.

**M. Meißner et al.**

mmeissn3@gwdg.de

Received and published: 23 July 2012

Thank you for your feedback on our manuscript. We appreciate the valuable comments provided. In the following we address your comments and questions. Our replies are written in italics below your comments.

**1) The deltaD profile in soil suggests that there is very little isotopic discrimination below 0.3 m in depth, yet the strongest results from the mixing models imply large differences in uptake between the 0.3-0.5 m layer and the 0.5-0.7 m layer. How is this possible?**



*The differences in soil water $\delta$D between 0.3-0.5 m and 0.5-0.7 m are not significant when averaged over all clusters (Figure 3). We included a new figure (Fig. A1) showing the $\delta$D values in stem water and soil water for all species in single and mixed clusters. The graph shows that stem water $\delta$D matched soil water $\delta$D in deeper layers (0.3-0.5 m and 0.5-0.7 m depending on species and mixture) which was confirmed and quantified by the mixing model.*

**2) What is the significance of the soil water potential measurements? They could be useful but are not applied in the paper beyond description. Soil water potential increases strongly with depth, suggesting that it becomes increasingly easier for plants to extract water as rooting depth increases. Now, if two soil layers (shallow and deep) with contrasting deltaD values were used as potential water sources, and plant deltaD were equal to the mean of these two soil deltaD values, we conclude that the plant extracts equal amounts of water from the two layers, but the fact that the deeper layer has a higher potential must mean that the tree actually must allocate greater root length to the shallow layer to extract as much water as it gets from the deep layer. None of this is discussed in the paper. This also means that volumetric water content as a function of depth does not measure water availability for the tree.**

*We agree. Soil water content alone doesn't provide sufficient information about soil water status and water availability to plants. Therefore, we decided to use soil water potential as an indicator for soil water availability as the energy required by plants to withdraw water from the soil can be inferred from soil water potential. Figure 3 shows that despite the decline in soil water content during the desiccation period water is still available to plants in all soil layers (still above the "permanent wilting point"). Indeed, during the soil water desiccation period plants can extract soil water "easier" from deeper soil layers, due to the higher soil water potentials which we found in our study (ignoring that they have to overcome the gravitational potential, too). In fact, most of*

*the fine roots are usually concentrated in upper layers. A study on fine root distribution conducted on 12 nearby study plots and on the same tree species also found that fine root biomass decreased markedly with soil depth with approximately 64-77 % being located in the upper 0.2 m of the soil profile (Meinen et al., 2009a). Therefore, we can assume a comparable root distribution for our tree clusters and species, with a higher fine root allocation in shallow layers and less in the deeper ones.*

**3) Why is only deltaD used and not delta18O, a more common water isotope for these studies? I believe deltaD values are more variable than delta18O values.**

*Since the establishment of the TC/EA isotope ratio mass spectrometry $\delta D$ is now as widely used as $\delta 18O$. The wide range commonly measured in water samples (here: $\delta D$ = -40 to - 70‰ explains the higher variability.*

**4) I am not sure that comparing the fractional water uptake among species layer by layer is the strongest statistical test. There are too many tests with weak statistical power. A joint analysis of the entire uptake profile would be more desirable. For example, a multinomial model could be fit to each species, and an analysis conducted to test whether specifying separate distributions for each species provides a better fit to the data than using a single distribution. Also, figures 5 and 6 should be combined, because the most interesting comparisons are not among species, but between the single and mixed species clusters.**

*According to your suggestion we applied a new statistical test to compare fractional water uptake jointly among species and the depth intervals of the entire uptake profile using a "linear mixed effects model" implemented R, version 2.11.1(model lme from the nlme library). The model output suggests that the significant effects are soil depth and the depth by species interaction in both single species and mixed clusters. We also combined the former Figures 5 and 6 in a new Figure 5 for a better comparison of*



*single and mixed species clusters.*

**5) The Phillips and Gregg method for constraining the mixing model for cases where there are more sources than variables is only an approximation, and the results depend on the assumptions of the analysis. A sensitivity analysis that examines how the results might respond to the assumptions made is warranted. In general, the authors might explain this technique further. The Phillips and Gregg (2003) paper cited (which appeared in Oecologia, not "Ecosystem Ecology") gives as examples systems with one isotope and three sources or two isotopes and five sources. Here we have one isotope and five sources. Isn't this pushing the bounds of this technique and if not, why not?**

*Compared to the 'graphical solution' where it is assumed that water is taken up mainly from one layer, a mixing model takes multiple sources into account. However, the outcome of the mixing model remains only an approximation. We included a paragraph in the method section addressing this issue. From a mathematical point of view we don't see any limitation of using one isotope and five sources.*

---

Interactive comment on Biogeosciences Discuss., 9, 5415, 2012.