

Interactive comment on “Responses of woody species to spatial and temporal ground water changes in coastal sand dune systems” by C. Máguas et al.

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We gratefully acknowledge helpful comments which have all been integrated as outlined below: Referee 1 “The introduction is a bit long and could be easily shortened” The introduction has been shortened by 8 lines, occupying now less than 2 pages Page2- Lines 15-17: eliminated Page2- Lines 26-29: large parte eliminated Page 3- Lines 19-21: eliminated “and P. 1596, In. 10: water potential measurements “were made on 5 plants per microsite : : ..”; It is not clear if this means that 5 plant per species per microsite were measured or just one per species (i.e., 5 plants in total per microsite). Please specify.” Measurements were conducted on 5 individuals of

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Interactive Discussion

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each species in each of the sites, with the exception of *P. pinaster*, i.e. a maximum of 25 plants per site. However, not all four species were present at all locations, and thus a total of 90 plants have been measured. The text has been clarified accordingly “This Page 1597, lines 5-12: The assignment of values equal to 0 Carbon isotope discrimination – It is now preferable to refer to Vienna PDB as the international standard.” This statement is not very clear concerning the comment on $\delta^{13}\text{C}$, however we add two new paragraphs for clarification. In particular we think that the model used is quite well known, but to facilitate the understanding we have added an additional piece of information In section 2.4.: Xylem water was extracted under vacuum distillation in the laboratory, and the oxygen isotopic composition ($\delta^{18}\text{O}$) of xylem water was determined as described above. Analytical performance was checked by measuring laboratory standards between samples. All $\delta^{18}\text{O}$ ratios are reported relative to standard mean ocean water (SMOW). In section 2.5.: Stable isotope mixing models are often used to quantify source contributions to a mixture. With the mixing model developed by Phillips and Gregg (2001), we may calculate the mean and the standard error of the fractional contributions of two different sources based on the uncertainty generated by the variability of both sources (Phillips and Gregg, 2001). Thus, the model uses a statistical error propagation calculation to generate error bounds (confidence intervals) around these estimates. In section 2.6 Results are expressed in δ notation and were standardized against Vienna PDB as the international standard. Page 1599, line 2: I suggest to change as follow: “The isotopic signature of GW was distinct and generally more depleted than precipitation: : ...”. According to the referee a clarification has been made: The isotopic signature of GW was distinct from that of precipitation, being in general more depleted than precipitation (Fig. 3), allowing the.... P. 1599, lines 13-18. This sentence is misleading and unclear. The seasonality effect was not equally evident in all species, but rather some species showed more season dependent changes in $\delta^{18}\text{O}$. From the analysis of Fig. 3, it appear that *Corema album* is not the species with most variable $\delta^{18}\text{O}$. In fact, Fig. 3 shows wide variations around means and medians. Please check comments to this figure. It should

be relevant to show $\delta^{18}\text{O}$ values measured in organics in different species and conditions. A full revision was performed according to major suggestions: According to the observations during two different seasons (Spring and Summer), plant species present a higher variability in xylem $\delta^{18}\text{O}$ during summer period. Xylem $\delta^{18}\text{O}$ values indicated that most species utilized a mixture between GW and precipitation during spring, (Fig. 3). During summer drought, due to the combination of decreasing GW levels and no significant precipitation, plants tended to have $\delta^{18}\text{O}$ signatures, which differed from GW signatures, and a larger variability was observed when compared to spring period (Fig. 3). However we must say that we did not perform any $\delta^{18}\text{O}$ analysis in plant organic material. Do Authors measure the O isotopic composition of plant material or of carbohydrates? In this study we only perform $\delta^{18}\text{O}$ analysis in xylem water, precipitation and GW. There was no analysis of $\delta^{18}\text{O}$ material in any type of plant organic material. Figure 6: the relationships between GW use and the C isotope composition are interesting. This would imply a differential impact of GW on water use efficiency in different species which is not surprising but deserving some more discussion. According to the referee comments discussion of these aspects has been intensified. However, we should also point out that the results concerning Figure 6, and in particular $\delta^{13}\text{C}$ are discussed by species or groups of species along the text in conjunction with other figures and tables. In fact, it is our aim to emphasize the value of $\delta^{13}\text{C}$ but not WUE, given the fact that bulk $\delta^{13}\text{C}$ from plant leaf material is not always a straightforward estimator of WUE. As already described in an earlier work (Werner and Máguas 2010) and others, care should be taken when considering the main ecological factors that lead to changes in $\delta^{13}\text{C}$. In our case rather than discussing changes in WUE, we focus on the changes in GW and its influence of $\delta^{13}\text{C}$ and the associated mechanisms. However and according to referee suggestions we have increased the discussion in what concerns the differential impact of GW on regulation of water relations and carbon gain. The text was changed to: Overall, $\delta^{13}\text{C}$ was a good indicator of heterogeneity in GW access ($p < 0.001$, Table 2), but a poor indicator of seasonal changes (in particularly drought) in carbon assimilation. This is in

agreement with recent studies demonstrating that bulk leaf $\delta^{13}\text{C}$ signatures of evergreen leaves are not always good tracers of photosynthetic regulation and water use efficiency, especially in Mediterranean habitats where most of the leaf structural carbon is produced during the growing season in spring (Werner Máguas, 2010). Thus, and as expected, under conditions that plants are using GW any decrease in GW use will lead to a strong impact in stomatal regulation, affecting carbon gain. This pathway was particularly evident for species such as *P. pinaster*, *M. faya* and *S. repens*, being all of them functional groups that had either developed root systems or they were GW dependent species. Moreover, it was also clear that this impact was stronger during spring when a high metabolic activity was observed, rather during summer drought.

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