Response to reviewer comments

I thank the authors for this revision of their initial manuscript where they accounted for most of my preceding comments. The incorporation of pressure probe derived root hydraulic conductance data is to me a very interesting added value to the paper, as is the simulation example coupling soil transfer – root uptake. Overall, this results in a very interesting, but "dense", paper.

We warmly thank the reviewer for his/her positive comments (also during the first review) that helped a lot to improve manuscript quality. We indeed believe that the lab data and the new simulations that were added following the reviewers suggestions increase the added value of our work.

To me, some minor revisions are required throughout the paper, but particularly in the new sections concerning pressure probe data inversion and root uptake in soil.

We took care of implementing almost all suggestions of the reviewer and we detail here after what was added/removed/simplified in the manuscript. We hope that our changes will satisfy the reviewer.

About root pressure probe data and inversion, it would be necessary to fix some scenarios (ie ~3) and explain them and their assumptions (ie why these conductance variations' scenarios) to make the study easier to read. Presently, Figure 9 is not really understandable and is not coherent with text description (non-coherent lines colours..).

We know that Figure 9 is dense but we wanted it to be exhaustive. By exhaustive we mean that a lot of different scenarios for radial conductivity distributions combined with the different changes of axial conductances are needed to be tested to illustrate the complete set of solutions. So we did not reduce the number of scenarios but we spent more time to explain them:

*"*In total six scenarios were considered: uniform radial conductivity and axial conductances alongside with a linear stepwise distribution for the axial conductance (that corresponded to the observations, see results section) combined with five different root radial conductivity distributions. The latter are linear, exponential, 3-stepwise, 2 steps linear piecewise and 3 steps linear piecewise distributions. Together they represent the complete set of solutions that were presented in this study.*"*

We double-checked and Figure 9 is coherent with text description. The confusion maybe comes from the y-scale of subplot b (letters were added as suggested) that is in log-scale, which makes the lines not straight and the exponential straight lines. Maybe another confusions comes from the fact that the best linear scenario (orange) is a constant line. We clarified these points:

*"*Note that the y-scales of the subplots are all in log-scale, this explains why the linear stepwise curves are not straight and why the exponential scenario is a straight line. Interestingly the best linear scenario (orange) is the constant function as it also can be seen from subplot b.*"*

What is a missing result from of this study is the fact that different solutions are possible for root radial conductance variations, even when axial conductance variation is known. This shows that more knowledge/measurement on local variations of root conductance is needed.

To know precisely the exact root radial conductivity distribution would indeed require more knowledge/measurement on local variations of root conductance. But our study already indicates that if this distribution is not exactly retrieved the orders of magnitude of the root conductivity are

retrieved at least for the sensitive parameters (tip root conductivity). This paragraph was added to explain this point:

*"*Clearly it appears that there are different solutions possible for the radial conductivity variations (light blue and mauve are equivalently good). However as shown in subplot b and c, the orders of magnitude of k_r, and as a consequence the radial conductivity to axial conductance ratio, are similar in these best scenarios. It implies that the experiment is sensitive to the changes of root radial conductivity even though more knowledge/measurement on local variations of root conductance would be needed to know accurately the root radial conductivity of the brace roots.*"*

Concerning the root in soil water uptake simulations (sections 3.3 – 4.3), there is a need to present/recap how is calculated the soil root water potential, as well as the soil water transfer. Why you choosed this scenario (i.e including growth in your case) needs to be also better explained and shall be recalled in interpreting results of section 4.3, with regards to this scenario.

We now clearly refer to the studies we used to calculate the soil root water potential as well as the soil water transfer, which was not done before as highlighted by the reviewer. However we did not give too detailed explanations as the paper is already dense enough. We now refereed to the original papers:

"The coupling between the root and soil water flow was achieved following \citet{javaux_use_2008}, i.e. the soil water flow is obtained by solving Richards equation, the soil-root interface potential is the distance-weighted soil root potential and soil and root equations are solved iteratively until convergence. For more details, see \citet{javaux_use_2008, couvreur_simple_2012}"

We included root growth to illustrate the moving sink of the growing heterogeneous root and its impact on plant water status. This was better stressed now in this section and we also recalled the motivation when interpreting the results of section 4.3.:

*"*We here considered root growth to assess how it impacts the sink location and hence the plant water status.*"*

*"*Here the roots are growing vertically in a homogeneous soil to assess the impact of water uptake location on plant water status.*"*

Surprising results are found in Fig. 10, where water potential (at collar, but soil too) increases with time for the heterogeneous root case : this is unexpected, but may be false? (check also the inversion between psi_collar and psi_seq in Fig 10 – see annotated paper).

First it must be said that indeed psi_collar and psi_seq were inverted in the figure and this error was corrected. Indeed for the heterogeneous root the potential increase over time (the absolute value decrease) but this is due to the water uptake locations that moves downwards for such root hydraulic distribution. This was better stressed in the text:

*"*Interestingly for the heterogeneous root both the soil equivalent and collar potentials increase after 5 days because, as the water uptake is mainly located at the root tip in such a case, new wet soil regions are explored by the active root parts (in terms of water uptake) and this impacts the root water status.*"*

The new, added part, final part of the conclusion is unclear for me. It could be stated more simply.

As suggested we simplified it as:

“The new models can used to derive local hydraulic properties of roots or be combined as building blocks to generate complete root system hydraulic architectures defining plant genotypes in order to compare plant performances in contrasted environments using soil-plant models such as R-SWMS \citep{javaux_use_2008}. To do so, it is needed to calculate the macroscopic parameters defined by \citet{couvreur_simple_2012} at the root system scale as a combination of the single root solutions proposed here at the single root scale. This will allow us to simulate plant root system water uptake of varying genotypes over the growing season in contrasted pedo-climatic conditions and hence to look for best genotype by environment interaction.”

Finally the “root conductance” expression is not really precise, as we don’t know exactly which conductance it refers to (cf line 4, p22 for example). I would suggest that when author refer to Krs (and not kr or kx) they could call it “effective root conductance” because Krs is indeed an effective macroscopic property emerging from geometry and kx, kr variations.

We now consistently called it effective root conductance throughout the manuscript following reviewer arguments.

See annotated pdf which recaps both typos/grammar and questions.

Again we thank reviewer for the annotated pdf that simplifies our job a lot.