Authors' response to interactive comment of the Referee #1

Black text: Referee comment

Blue text: Authors' response

We thank the reviewer for the valuable comments and suggestions to improve our contribution. We provide point-by-point reply below.

Abstract: there were several models mentioned in the abstract, which makes readers confusing for the first impression. To make it clear, I suggest to use the name that the author described in section 2.3.5: HILLFLOW–Couvreur–SLIMROOT–LINTULCC2 for the newly coupled model and HILLFLOW–Feddes–SLIMROOT–LINTULCC2 for the commonly approach at line 18

The name of the coupled model has changed in the abstract that it is consistent with section 2.3.5.

Introduction: The author wanted to simulate the water and gas fluxes for different water and soil conditions considering dynamic plant hydraulics. The importance of dynamic plant hydraulics was well presented. Dynamic plant hydraulics related to root growth so root development was needed. The author used SLIMROOT but did not mention and explain why it was chosen in the introduction.

The coupling root-shoot model required a use of root growth model. For a valid comparison, it is necessary to couple both RWU models and water balance model with the same root growth model. From this point, root growth model with dynamic root growth (over time and soil layers) was chosen to inform the root depth, root length, and root length density (or normalized root length density) for Feddes and Couvreur RWU approach. Thus, the authors thought that it might not be necessary to mention and answer why SLIMROOT was employed right away from the Introduction section. However, the SLIMROOT root growth model was described in detail in the section 2.3.2.

Methods and Materials:

This manuscript described five different models and each of them has different parameters (input and output). It's good that all the parameters and related values were listed in the supplementary materials. These five models were coupled in two different ways and the input or output of the models were used from each other. I suggest the author draw a diagram or flowchart to describe the connection between the models, which will definitely help readers to understand better.

The modelling couple was the same for both RWU approaches. The coupling configuration namely linkages of shoot growth, root growth, water balance, and root water uptake model was the identical to ensure the analysis and comparison of two different RWU models. As suggestion of referee's comments, a diagram was added (see Figure 2). A short paragraph was added to describe shortly the Figure 2.

"For a certain hourly time step $\Delta t_i = t_i - t_{i-1}$, different modules were solved in the following sequence. First, LINTULCC2 was used with a water stress factor fwat =1 to calculate the leaf and canopy resistance, and the potential transpiration rate. T_{pot} was then used in HILLFLOW 1D to calculate the soil water pressure head changes, water content changes, the actual transpiration, and fwat during the time step. LINTULCC2 was then run again using the fwat. The leaf conductance and assimilation rate were calculated. For the next time step, the same loop was run and hourly assimilation was accumulated to a daily value. Daily assimilation rates were used in modules that run with a daily time step. For instance, modules of LINTLCC2 that calculate assimilate partitioning which is used to calculate shoot (LAI) development and passed to SLIMROOT to simulate root development (Fig. 2)."
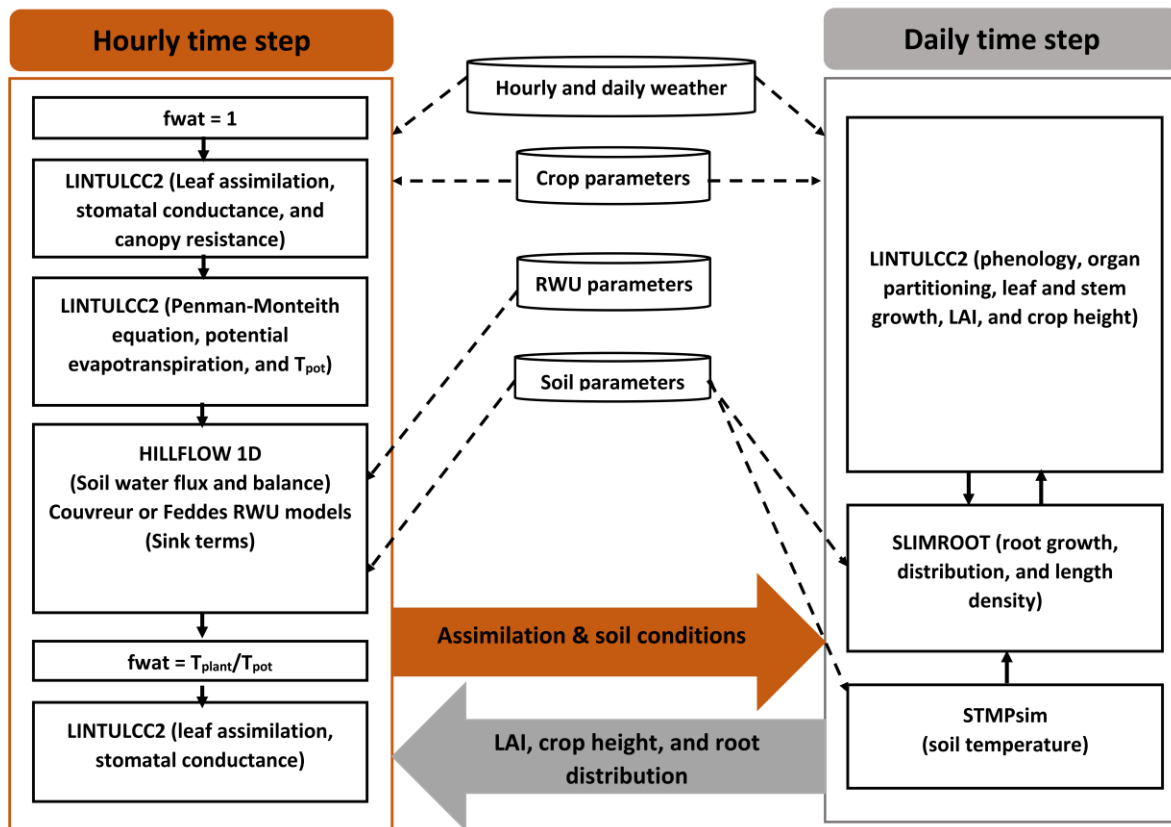
Figure 2: Description of the coupled root: shoot models in the study. The orange arrow indicates feedbacks from the hourly simulations to daily simulation while the grey arrow indicates feedbacks from the daily simulations to the hourly simulations. The dashed black arrows denote the weather input and parameters to the subroutines. The continuous black arrows indicate the links amongst the modelling subroutines.

For the root growth model, soil water content and soil temperature were needed for the simulations. It seems that the author used simulated results from two separate models. Why did not the authors use the measured data from the soil sensors for the root growth simulations?

The authors can used directly the measured root growth which was collected weekly by rhizotubes for the daily simulation by assuming root growth will not change much within one week (as similar to the work from Cai et al., 2017; Cai et al., 2018). In addition, the measured soil water content and soil temperature can be used as the "forced input" for the root growth simulation. We used the "forward modelling approach" which weather data, soil, and crop parameters are the input for two coupled models. Soil water content is simulated by water balance model HILLFLOW 1D. The soil temperature is calculated by the subroutine in the root growth model (STMPsim, Williams and Izaurrable, 2006) (see the new diagram Figure 2). The output data for instance here the performance of root growth simulation was evaluated directly with the observed root data while the simulated soil water content was compared with the measured soil water content data.

Stomatal conductance (gs) could also be used for explaining the variation of the transpiration, especially for dry conditions. The reduction in gs shows water stress. Since these data were available (Appendix A) the variation of gs and fwat could be related somehow. The author could show and discuss it in the results and discussion part.

The leaf water potential is surrogate of stomatal regulation our study. By showing simulated leaf water potential, transpiration, gross assimilation in comparison to the measure data (Fig. 8), our work has showed that the model is able to simulate water stress effects on leaf water potential and gas exchange in different measured days (for instance Couvreur model). As suggested by the referee, the simulated stomatal conductance to water vapor (here from sunlit leaves) was compared with the measurement from 3-4 upmost fully developed leaves. Two sentences were added to describe the measurement of leaf gas exchange together with leaf water potential and one sentence was add for the simulation results of stomatal conductance in comparison with the measured ones.

Results and discussion: line 479 and this paragraph were a little bit off, especially the comparison between the modern and old cultivars. This part could be either skipped or connected with a better explanation.

This paragraph was removed and improved (see also reply to the comments with sensitivity analysis section from referee # 2)

Conclusion: the aim of the study, drawback of the models, and further investigations were well presented. The three objectives of the study were posted at the end of the introduction and they were tested in the manuscript but not all of them were mentioned in the conclusion part. Normally, answers should be given in the end.

The Conclusion part was revised (together with comments from referee #2)

Line 10: the sentence is really long, please rephrase.

This was rephrased and shortened down.

Line 22: LAI is not defined before, please give the full name, leaf area index

It was given full name.

Line 30: 'promissing' – 'promising'

It was corrected.

Line 39: move (RWU) to the former 'root water uptake'. Please also check the usage of 'RWU' and 'root water uptake' in the text below. Once it is described, the abbreviation should be used afterwards.

 It was moved.

Line 47: 'in an indirect manner' – 'indirectly'

 It was corrected.

Line 50: 'models of root water uptake' – 'RWU models'

It was corrected.

Line 65: delete 'shoot'

It was deleted.

Line 86: missing the 'period' symbol

It was added.

Line 106: delete 'soil property' since the soils have been described before

It was deleted.

Line 110: 'side' – 'sides'

It was corrected.

Line 112: 'was' – 'were'

It was corrected.

Line 115: 'rain-fed' – 'rainfed' and also check it in the text below

It was corrected and made consistently for the next paragraphs.

Line 119: … sap flow was calculated …

It was corrected.

Line 123: '8pm' – '8 pm'

It was corrected.

Line 130 and 131: '6' – 'six'

It was corrected.

Line 132: use am (pm) or AM (PM) in the whole text

These will be made consistently in the whole text.

Line 150: 'above ground' – 'aboveground', and also check it in the text below

These will be changed consistently in the whole text.

Line 151: the detailed measurements of biomass, especially the different organs, were described but not used later. This part could be skipped

It was kept like this because the separated organs need to be measured then the total aboveground biomass is determined from the sum of different organs.

Line 162: … model of Farquhar and Caemmer (1982)

It was corrected.

Line 165: For the sake of …

It was corrected.

Line 167: check the format of the citations in the bracket

It was corrected with the right citation format.

Line 171: give the full name of LAI

The full name of LAI was added

Line 190: keep 'Hillflow1D' and 'HILLFLOW 1D' the same in the text

It was corrected and made consistently in the text.

Line 229: 'fwat' – 'fwat' and also in Figure 4

It was corrected.

Line 323-324: Not clear. It is better to have two different colors or symbols to differentiate the two samples.

These were two replications of biomass and LAI. It was rewritten for better understanding.

Line 325: do you use the mean r2 of the six plots? If so, you need to mention and also re-calculate them. It seems that 0.91 and other values are not the mean of the six values.

The r^2, RMSE, and I were calculated when all measurements from 06 plots were pulled together (they are not the mean of six values from six plots).

Line 343: use 'minirhizotube' or 'rhizotube' in the text and in the caption of the figures

The minirhizotube will be used and changed consistently in the text and the figure captions.

Line 363: … show the simulated …, by the …' – '… show …, simulated by …'

It was revised.

Line 407: 'Pg' is not defined

Pg will be defined in the text.

Line 463: 'increases' – 'increase'

It was corrected

Line 477: 'is' – 'are' Figure 2,

It was corrected.

Line 879: 'green' – 'cyan' (used in Figure 2 and 4) Figure 4: make the size of the four subplots (a, b, c, d) the same for better comparison Figure 4,
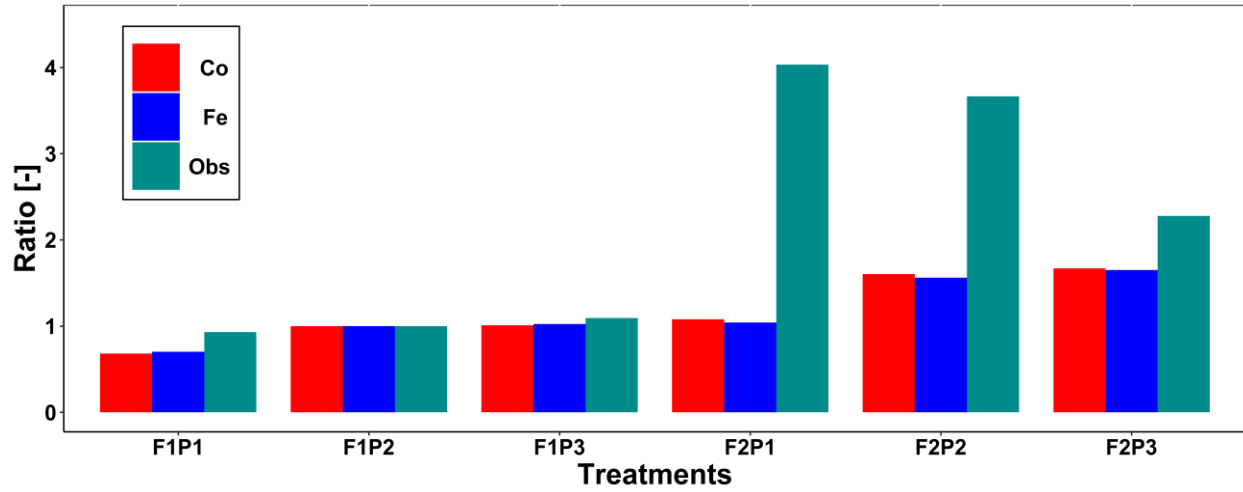
It was corrected. The size of the subplots will be similar in Figure 4.

line 934: Pg? Please give the full name

The full name was added.

Appendix F: bar plot will be better for the comparison

It was converted to bar plot.

Appendix F: Comparison ratio of the observed total root length from minirhizotubes to observed total root length from F1P2 (green line with squares) and ratio of simulated total root length to the simulated total root length from F1P2 on 11 July 2016 (DOY 193) from Couvreur (Co, solid red, dots), and Feddes (Fe, solid blue, triangles) model at the sheltered (P1), rainfed (P2), and irrigated (P3) plots of the stony soil (F1) and the silty soil (F2)