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Interactive comment on "Root uptake under mismatched distributions of water and nutrients in the root zone" *by* Jing Yan et al.

Anonymous Referee #3

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This manuscript presents experimental evidence that plants can satisfy their water and nutrient demand from mismatchingly distributed water and nutrient resources, if the overall available amount is sufficient. The plant adaptation strategies and regulating mechanisms related to this are discussed. Overall, this is a well-designed contribution of high interest. However, the methods in part lack clarity, and the results and discussion are in parts too speculative. My first two points are about nomenclature: Comment 1: The first is the definition of the term rhizosphere. There are different ways in literature how to use the term rhizosphere and thus I think it is important to define clearly what this term means in this paper. I think this paper rather means a part of soil which has a high root density, i.e. it is more used in the meaning of "root zone". That could be confusing as a lot of other work understands the rhizosphere much more locally in

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form of gradients in the concentration of root-influenced solutes or other compounds extending from the root surface to the 'bulk' soil (Darrah et al., EJSS 57, 2006). Comment 2: The second is the term "exudates". It is often used quite differently in different papers. I rather tend to distinguish "root exudates" as low-molecular weight organic carbon (such as citrate, sugars) and mucilage. An overarching term that includes both exudates and mucilage would be "rhizodeposition" (Oburger and Jones, Rhizosphere 6, 2018). I encourage the authors to also use this nomenclature.

Some methodological aspects were also not clear to me: Comment 3: I could not find in which depths the water potential sensors were installed. I could also not infer in how far it is justified to call the resulting value a "rhizosphere" water potential. Is it not rather the water potential in the soil layer that has the highest root length density? One could understand this from your sentence on page 3, line 64: ". . .to measure the water potential of the root zone". Comparing the water content that was computed from the rhizosphere water potential (Fig. S5c) with the water content that was measured with the dielectic water content sensor that was installed in the middle of the compartment (Fig. S3a), I can hardly see a difference. Comment 4: How can you be sure that the water increase in the root zone with highest root length density results from HR? Root water uptake and injections will create water potential gradients within one compartment that could result in redistribution of water in the soil.

Comment 5: The structure of the paper needs attention. I suggest, for example, to move the paragraph lines 105-115 page 4 to the description of the split-root experiment in the Methods section. Then, the "D" and "C1" will be easier to understand in line 64 on page 3.

Some claimed results seem a bit too speculative to me: Comment 6: The reason for root accumulation at the bottom could also just be that the pot was too short. I.e., if almost all the carbon in C1 is invested in the wet and nutrient rich compartment, it may be possible that the roots would have grown much deeper than in the other treatments if they had been given the space. Comment 6: "Moreover, multi-scale signalling and

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feedbacks appear to be involved": How could you support this statement with your results? Comment 7: While it is known that hormonal signalling may regulate the transpiration demand at the leaves, the water flow into our out (HR) of the roots follows (passively) local hydraulic gradients between xylem and soil (e.g. Rothfuss and Javaux, Biogeosciences 14, 2017). What regulation mechanisms exactly do you mean by your statement "HR is biologically-mediated"? Would that be regulation of root hydraulic properties? How could you support that with your results?

Minor comments - I could not see that the number of replicates was mentioned in the Methods section. P3 L57: How long did it take the plants to reach that height? P3 L59: How many roots were there at this stage? Was the tap root recognisable and was there a strategy to place it into a specific compartment? P3 L85: When you scooped out the soil, did you cut the roots within these 2cm intervals? Fig. 2a: I do not see the relevance of Fig. 2a. I also suggest to split the rhizosheath and root mass distribution to two separate figures. Fig. 2h: dry and wet labels are confusing for this treatment. P8 L165: "taken up by the roots" P11 L211: The absence of HR in C1 was not mentioned in the Results section.

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