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Biogeosciences Discussions

Interactive comment on "Multi-frequency electrical impedance tomography as a non-invasive tool to characterize and monitor crop root systems" *by* Maximilian Weigand and Andreas Kemna

Anonymous Referee #3

Received and published: 24 November 2016

This is a very interesting paper using multi-frequency electrical impedance tomography as a non-invasive tool to monitor plant root activity.

I liked very much the introduction and also the second chapter, where a review on electrical polarization on roots and on polarization of biomatter is realized. I also appreciated the definition of working hypotheses.

The result section is in general clear and well written. I have some minor concerns though with the result plots, where labels, axes, captions are not always clear (this has been solved in the meantime:please do not consider all remarks on plots)

I had a problem to follow the discussion on the biological interpretation of the mea-

surements but maybe I misunderstood what authors meant. I think this section would benefit from a clearer explanation. Additional measurements, which would support these explanations should ideally also be provided or at least discussed. I only have minor comments, which are summarized here below.

Comments p.6, l.13: define hat zeta potential is

p.6, l.30: "the matter between" :in biology, this is called "root cortex"

p.7, l.20: this is the first time you mention cell wall. You should explain in the review before why it is important (it is not explicit in the text at the end of p.6).

p.7, l.20: define "plasma membrane": is it cell membrane?

p.8, l.33: is there a reason why the error model is only on the resistance on not on the phase as well?

p.9, l.24: replace "depth" by "thickness". Figure 1. In the plot caption, explain the meaning of the arrows and of the number or refer to the text.

p.11, l.16: is this correction independent on the background concentration?

Figure 3: put axis labels, delete the subplot titles and add a, b, and c

p.13, last line: give the lateral extent as well.

Figure 5. add units on the axes. Explain the numbers of the color line (i.e., hours and days?)

Figure 6. add subplot letters, units and axis labels. Add a scale on the photograph.

p.16, first lines of section 4.4.: could you show these area on one of the rhizotron photographs that you showed before?

p.16, l.5: do you mean thick and thin root segments? "Large" is not really accurate. Try also to avoid using the word "root" throughout the manuscript, which is sometimes used for a root system, sometimes for a root brench or sometimes for a root segment.

Clarify throughout the text.

Figure 7. same comments than before about subplot titles, letters and color legend. You should also add a gray zone here where results are below measurement accuracy.

Figure 11. Axis labels are not visible.

p.20, L.21: add “electrical” before conductivity

p20, L.21: add “solution” after “rhizotron”

p.20, l.22: root water uptake only cannot explain an increase of the salinity. This is only the case if solute uptake rate is lower than water uptake rate.

p.21, l. 13: “Accordingly. . .”I don’t really follow the reasoning here. (1) A general increase of solute concentration is observed in the liquid phase (see end of previous page). (2) that would mean that there the water uptake is lower than the solute uptake (i.e. exclusion of solute): the extracted water by plant will thus have a lower concentration than the rhizotron water, which should lead to an increase of solute concentration around roots (due to exclusion). (3) an additional question is whether chemical diffusion in water does not counterbalance this gradient of concentration around roots. Yet, I am not sure what the authors mean by "outer root region": do you mean the root cortex? Or the part of the root zone which is at the edge of the root system? or do you mean the rhizosphere?

P21, L.16: “nutrient”: is it on purpose that you speak about nutrient here and not about all solutes. Do you mean that some solutes are excluded by roots and that nutrients are taken proportionally or more than proportionally to water uptake? As a function of the ratio between nutrient and the other ’useless’ solutes, that could result in an increase of the salinity but a decrease of the nutrient concentration (?) Please clarify

P21, l.20: it would be good to support this hypothesis of stress with data: nutrient concertation in the solution at the end of the experiment, salinity level, plant transpiration decrease with time, ... Do you have them? At least you should discuss that these

informations would have helped support your interpretation.

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