Interactive comment on “Electrical capacitance Volume tomography of soil water infiltration in vessel experiments

The authors would like to thank of reviewers for their objective comments on our manuscript in order to improve our research contribution in this manuscript. The authors addressed all the reviewers comment hereafter and accordingly prepared the revised version of the manuscript. All the changes have been underline in the revised version of the manuscript.

Reviewer #1:

General comments: The topic of imaging of soil column water flow and solute transport is of great interest to the hydrology, soil science, and geophysics communities. The ECVT technique appears to work well and the results for the soil water infiltration experiment look promising. The paper is concise and relatively easy to understand. The use of the English language needs to be improved. I would like to see some more information on the effect to electrical conductivity (EC) on the measurements. Did you take special precautions to wash the river sand? Did you used di-water in the columns or tap water? How high can the soil water EC go before energy losses start to affect the capacitance measurements? Or, is EC not a problem?

Reply:

The authors thank the reviewer for this comment. In this soil water infiltration experiment study, we used river sand without any special precautions to wash the river sand. While, for supplying water in soil vessel we used tap water.
In addition, the explanation of electrical conductivity was added in the third paragraph on section “Methodology”: In fact, water, air and sand have a value of electrical conductivity (EC). EC values contained in these three materials will affect the capacitance measurement. However the value of the material is very small then it does not affect significantly. So the EC effect on this experiment can be ignored (see page 12).

Specific comments:

Title: change to“..infiltration in vessel experiments” (remove “a”)

Reply:
The **title** has been changed as the reviewer suggested.

Comment:
P1368L18 the first two sentences of the introduction need to be rewritten. The second sentence, for example, states that we need to understand the infiltration process to understand the infiltration process. This is circular.

Reply:
P1368L18: the sentence is changed to "A better understanding of the soil water infiltration process is essential to figure out and predict dynamic soil water infiltration and solute transport in unsaturated soil slope".

Comment:
P1369L4 the disc infiltrometer seems out of place here. This is not an imaging tool.

Reply:
P1369L4: delete "disc infiltrometer (Moret and Gonzalez, 2009),"

Comment:
P1369L24 Maybe also provide the permittivities of air and solids here.

Reply:
P1369L24: the sentence is changed to "Because the dielectric constant of water is greater than others, i.e., 81 meanwhile air is 1 and dry sand is 20 – 30 for frequencies less than 1000 MHz,the value of the dielectric for the soil depends on the water content (Kutilek and Nielsen, 1994)."

Comment:
P1369L25 Is 1000 MHz the EM frequency at which you measure the capacitances? If not, what is the frequency

Reply:
P1369L25: The frequency that used in this study is 1000 MHz

Comment:
Eq.1 Notation-wise this equation uses both the operator form and Cartesian coordinates. Can you pick one?

Reply:
Eq. 1 has been revised as shown page 6 ln 7.

Comment:
Eq.2 Qj instead of Qi,j

Reply:
The authors thank the reviewer for this comment. Eq. 2 has been changed as shown page 6 ln 14.

Comment:
P1370L17 Eqs. (2) and (3), not(1) and (3)

Reply:
P1370L17: The authors thank the reviewer for this comment. The Eqs. Numbering has been changed as shown in page 7 ln 4.

Comment:
P1371L5 Perhaps explain what is meant by "active differentiator"

Reply:
P1371L5: The explanation of active differentiator has been introduced as follow: "The active differentiator circuit consisted of capacitance, resistor and operational amplifier. The output voltage of this circuit is proportional to the time derivative of the input voltage. By using the technique that developed by Harteveld et al (1999), the unknown capacitance value can be found". (see page 7 ln 12-15).

Comment:
P1371L15 Please explain what is meant by "soft field"

Reply:
P1371L15: The soft field term has been explained in page 8 in the second paragraph.

Comment:
P1373L15 What is meant by "four planes" ?

Reply:
P1373L15: In fact, 1 plane is consisted of 8 plate electrodes (also called channel) which are in around of the vessel (radial axis view). There are 32 channels, so that's why there are four planes (axial axis view).

Comment:
P1374L17 "soil density" is "dry bulk density"?

Reply:
P1374L17: in our study, it is correct this is due to the fact that we make the measurement for the density in the laboratory.

Comment:
P1374L20 "capacitances were measured iteratively". Do you really mean "iteratively"?

Reply:
P1374L20: The authors thank the reviewer for this comment. The word iteratively was wrongly used and this sentence has been changed "During ponded condition, the data capacitances were measured and transfer directly to the computer." (see page 13 last paragraph)

Comment:
P1374L23 Would it be feasible to use saturated soil as (wetted from the bottom up to prevent air entrapment)? That way, later on, any normalized value <1 would indicate air entrapment in the soil column.

Reply:
P1374L23: The authors agree with the reviewer in this comment and the authors see that it is feasible to use this saturated soil and it is confirmed that the normalized value indicated air entrapment as indicate in Figure 9 (page 15).

Comment:
Fig.1 Does each hexagonal panel constitute an electrode?

Reply:
Fig. 1: the term of "electrode" and "channel" are same. The form of an electrode is a plate which is a hexagonal form.

Comment:
Fig.4 this figure requires more explanation. What is the z axis of the sensor and why is it dimensionless? Are the dead zones physically on the left and right of the columns or at the bottom and top?

Reply:
The authors thank the reviewer for this comment. More explanation has been introduced for more clarification about Fig. 4 (see page 10 first paragraph). In fact, in Fig. 4 Z-axis is not dimensionless but its unit is "cm".
Dead zone physically is on top and bottom of the column.

Comment:
P1368L15"distribution"doesn't seem to be the correct word

Reply:
P1368L15: the word "distribution" has been deleted.

Comment:
P1375L5“column”instead of“medium”?

Reply:
P1375L5: the word “medium” has been changed to “column”.
