

## ***Interactive comment on “Monitoring infiltration processes with high-resolution surface-based Ground-Penetrating Radar” by P. Klenk et al.***

### **Anonymous Referee #1**

Received and published: 2 January 2016

First of all I apologize for giving this review two weeks after the initial deadline, and I thank the editor for been comprehensive.

Scientific significance: "Does the manuscript represent a substantial contribution to scientific progress within the scope of Hydrology and Earth System Sciences (substantial new concepts, ideas, methods, or data)?" (3) Fair. The method is very interesting itself, but the analytical and processing development needs to be ameliorated.

Scientific quality: "Are the scientific approach and applied methods valid? Are the results discussed in an appropriate and balanced way (consideration of related work, including appropriate references)?" (3) Fair. The method is valid, but the authors needs to go a little bit further in using the two frequencies and uncertainties.

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Presentation quality: "Are the scientific results and conclusions presented in a clear, concise, and well-structured way (number and quality of figures/tables, appropriate use of English language)?" (2) Good. Some special and unusual phrasing though.

General comments: I would like first to thank the authors for the work they carried and acknowledge them to be part of the scientists who use and ameliorate GPR as a tool for monitoring infiltration.

I found the study original and pleasant to read. I really like the idea of monitoring infiltration with a dual frequencies antennae. However for accepting this work to be published I have three remarks (questions) the authors need to address/answer for the next version:

- What is the sampling depth of your direct wave? It comes to my mind as well, what about the coupling of the antenna during infiltration? The surrounding media is evolving through time, what do you think about the influence of this evolution on your direct wave?

- Let us suppose you have a picking uncertainty of 0.16 ns ( $2*dt$ ), what is the difference in water content. What I mean by that is, stating 0.001 cc/cc is very very fine determination, so I think you need to speak a bit more about this. I am not asking you to draw a full uncertainty analysis, just at least to give us more information and maybe some warning and precaution about the ultrafine measurement of 0.001 cc/cc.

- In term of monitoring infiltration, what your dual frequency method can bring (not necessarily on this study)? You are not emphasizing enough on the advantages of your method. I am just wondering if the 200 MHz is the most suited tool to follow near surface infiltration.

If the authors can answer/address these three questions/remarks I would not see any problem for this publication to be accepted.

Specific comments:

Abstract line 5: "0.001 [-]". state gravimetric or volumetric [g/g] or [cm<sup>3</sup>/cm<sup>3</sup>].

Page 18, Lines 9 and 12. Accent display problem.

Figure 1: Why do you have two different red (dashed and plain ) lines for the two infiltration spot ? Does not need to be changed, just wondering if you modified the original figure from Klenk et al. 2015.

Page 19, Line 20: "hydraulic equilibrium". Do you have tensiometers or other devices on site ?

Page 20, Line 6: "The sketch in Fig.4". It should be Figure 3, since this is the third you are mentioning.

Figure 4: Is there a layer of wood ? If yes you need to draw it in the sketch, or mention it.

Figure 3: Y-axis, depth cannot be negative.

Page 21, Line 3: I'm not sure the term relaxation is the most suited. What about "drainage" ?

Page 21, Line 20: "Soil water contents [-]". I assume it is volumetric, then it is cm<sup>3</sup>/cm<sup>3</sup>.

Page 22, Line 10: "efficacy", what about efficiency?

Page 22, Line 14-24: I think this paragraph should come after. It is too early to speak about additional material, since we haven't seen any material first.

Page 23, Line 20-25 and figure 6. "These variations may indicate unresolved signals interfering with the respective direct waves [...] 200 MHz ". I disagree, you took the same time step for the 200 MHz and the 600 MHz ? Then the sampling of you 600 MHz and 200 MHz is not the same, and your picking uncertainty (or variations) is not the same depending on your frequency. On the figure 6, could you display the RMSE

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between blue and red curve and can you compare it with the 0.1 ns you are mentioning ?

Page 24: Did you carry some TDR measurement on you sand ? To get the permittivity.

Page 29, Line 17: "increasingly minute". Rephrase.

Page 29, Line 24: "0.001", unity. I disagree. You have to give us some uncertainties on your picking at least. Give us a sensitivity analysis.

Page 30, Line 1. Are you planning to conduct lab experiment (hydraulic conductivity test) on soil samples?

Page 30, Conclusion, Line 26: Units for volumetric water content.

References: Page 33, Line 14, Line 17: Missing letter with the accent. Page 34, Line 1, Line 15: Same issue.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 12215, 2015.

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