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# Comments to

# Estimating field-scale soil water dynamics at a heterogeneous site suing multi-chanel GPR

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## General Comments:

Pan et al. presented in the manuscripts (ms) a field experiment where they analysed the feasibility of multi-offset GPR to monitor the soil water dynamics in a sandy dune environment. The study is based on the idea that multi-offset GPR contains enough information to estimate the reflector depth as well as the water content above the reflector simultaneous. In general, the ms contains novel approaches and ideas to characterize the shallow subsurface water dynamics non-invasively, and is therefore suitable for HESS. Unfortunately, the ms is not always well written and need substantial improvement before publication. I would also recommend checking the ms by a native speaker to clarify sentences and to improve the argumentation line.

## Specific Comments:

## Abstract:

In general, I do miss out some major findings in terms of hard numbers of hypothesis verified. To say that multi-offset GPR is a powerful tool for estimating the boundary layer depths and the water content above this layer is not enough, especially because this has been already demonstrated.

## Introduction:

P8029 L3: please introduce TDR (time domain reflectometry): Additionally, Theta-Probe is only a brand name. It should be more general such as capacitance sensors or frequency domain sensors.
P8029 L11-13: weak sentence
P8029 L17: should be Huisman et al. (2003a), Lambot et al. (2008), and Slob…..
P8029 L28: Weak sentence.
P8030 L1: this is not fully correct. It measures the surface reflection coefficient (or backscattering coefficient) but is can also use the full waveform to draw information from the subsoil - this would be totally different from the methodology used in remote sensing.
P8030 L5: I do not believe that the papers listed up showed any soil water content profiles. Please check again.
P8030: L27: it should be: … would help to understand…
P8030: L28: it should be: … on crop growth…

## Site description and measurements

P8031 L7: it should be: … of land area.
P8031 L12-17: weak sentence
P8031 L20: do you come back to salinity later? If not please delete the information as long as it is not of any importance for the signal retrieved.
P8031 L28: I would use the term soil layering instead of architecture.
P8031 L29: referring to Fig. 1: maybe clearly indicate which reflection is clearly caused by stratigraphy. This would help the non GPR readers.
P8032 L25: would be better to use drilled instead of conducted.

**Chapter 3.1:**

This chapter needs some more information, especially for the non GPR specialists. Additionally, even if someone else already introduced the methodology how to calculate water contents from travel times the methodology should be explained here.

P8033 L10: please insert unit after depth d. This should be checked for the entire ms.
P8033 L11: please introduce CMP
P8033 L14: please add reference for the CRIM model.
P8033 L15: please provide units for Theta (I know that it will be dimensionless but gravimetric water content will be also without any dimensions. Please check entire ms or name it volumetric water content.
P8034 L5: please add references

## Result and Discussion:

P8035 L3: should be … borehole sampling information as listed in Table 1 from seven….
P8035 L13: how did you obtain the maps? Did you use ordinary Kriging? Otherwise you should have discrete block data and not a smooth map.
P8035 L21: as introduced by Pan et al. (2012)
P8036 L4: is assessed by the data of the seven boreholes..
P8036 L28: Again I would add the units to indicate that vol. water content is listed
P8037 L1: and L2: same as above
P8037 L11-13: I would not call it truth. Both are reliable but as mentioned above measured at different scales. As you showed earlier in Fig. 8 water content distribution is not uniform within each layer, and therefore, GPR must give you a different value.
P8037 L19: what is significant? Are the differences between lines are significant? Did you performed a test on significance?
P8037 L23: which amounts do you mean?
P8038 L7: please provide units if it is vol. water content.
P8039 L2-L6: This might be only a hypothesis but I would argue that the actual ET might be also wrong, especially if calculated by such a simple equation.
P8039 L21-L22: That's an assumption only. Do you have any data supporting the assumption?
P8039 L22: what do you mean by loss rate?
P8040 L3: "various models in the laboratory" – what you mean? Hydrological models? If yes, why laboratory?
P8040 L3-L7: what do you want to say by this general statement?
P8040 L8: … uncertainty … Please add references
P8042 L3: I do wonder why you do not see the same pattern in crop growth and within the GPR maps shown in Fig. 5 and 9.

## Conclusion:

The entire conclusion needs modification. At the moments it is somehow confusing and therefore weak