Review Report

Calculation of soil water content using dielectric permittivity measurements; benefits of soil-specific calibration.

General remarks

I consider this manuscript as a draft version which needs considerable further elaboration to become a well structured and informative paper. The measurement basis is good but the statistical analysis and results need to be presented and discussed more thoroughly.

I also advise to improve the English language considerably.

Some general suggestions for improvement:

- **Introduction** needs to be extended including more recent references and findings on this topic. At the end of the introduction readers expect clear objectives of the study, or a list of research questions. These need to be addressed in the Discussion and Conclusions.
- In **Material and Methods**, clearly describe the test sites and sampling procedure, and inform the reader of the type of soil and its clay and organic content by depth layer in a table. Also, clearly describe the laboratory setup and refer to the protocol in Appendix A
  Describe the statistical analysis, and introduce some measures for assessing bias and precision to evaluate the recalibration performance
- In **Results & Discussion section** use Tables to evaluate the performance after recalibration**,** but also to show the difference between using the real part or modulus of dielectric permittivity
- Provide in Discussion some answers to “What is acceptable accuracy of SWC measurements ?” and “What is the minimum set of replicate samples per depth needed for proper recalibration ?”
- In **Conclusion:** how are your research questions answered and objectives reached ?

Below you can find comments by Line, also for the numerous typo’s. Hope these can help you to improve the MS.

Introduction

L21. Climatic “soil” variables – add “soil”

L26. Accuracy of 3%, do you mean 3% absolute (so volume %), or 3% relative compared to the gravimetrically determined SWC ?

L27. What do you mean by “points” ? Measurement locations ?

L29. “Roods” must be Probe “rods”

L37. Remove “usually”, OM is never represented in a soil textural triangle

L49 both are dependent on linking accurate soil capacitance with soil water content

L50 traveling “through” the rods

L55 roods => “rods”

L71. choose the right probes for specific soils such as clayey soils => what are the specification of such rods ? Explained further ?

L74. To recover a more accurate measurement => to reach a more …

L75. but even for a particular pit and particular depth for accurate SWC measurements. => see paper: https://www.mdpi.com/2076-3417/11/24/11620

M&M

L79-85: I suggest to put the applied sensors in a table listing their characteristics (also rod lengths), as for example in Table 1 of https://essd.copernicus.org/articles/12/683/2020/

L86-92. Nice ‘home made apparatus” – Have you checked bulk density differences compared to conventional volumetric sampling ? is the sample really taken by pneumatic hammering ? Or just pneumatic forcing into the soil ? What if there is a stone content in the soil ? How do you cope with samples containing coarse fragments ?

L95. So from Figure 2 I conclude you have 4 replicate SWC pits in FR_Aur and 5 in FR-Lam ? Please specify. Landuse is cropland ?

L 98. Refer to ICOS programme (https://www.icos-cp.eu/)

L105. As an illustration for this paper, some FR-Aur results are shown.Where ? Please refer to figure or table

L106. Why are samples taken differently in the topsoil (vertically) compared to the subsoil layers ? I would take them all horizontally for a study.

L105-109. Here you do not mention any hammering ? Just pressure.

L110 “was near water-saturated” – water saturation, but probably you mean the soil was at “field capacity”.

L119.. List the properties of the analog and digital FDR probes in the instrument table please, so that the reader knows which devices these are.

L128. Cracking is indeed one of the biggest problems of FDR measurements in clayey soils. You can avoid it in the lab, but how to cope with this in the field (especially topsoil) ?

Results and discussion

L154 “Are the cack volume parts of the sample
volume?” – typo “Crack” – by convention dry bulk density is the ovendry mass of soil (dried at 105°C) devided by its volume when taken in the field, mostly at field capacity. So in this sense, when a clayey sample dries out and is cracking, the crack volume is part of the sample volume, and no substraction is needed. Therefore it is called “bulk density”, because it also includes pores, and channels, and cracks … in contrast to specific density of soil.

L160. Figure 4. It would be informative to show progressive crack formation upon drying and this SWC- diel. Permittivity relationship.

L165-167. This is probably linked with the fact that the tested soil samples originate from arable land that is homogenised by ploughing. In forest and permanent grassland soils topsoil variability is usually greater and less homogenous.

L170.(and L182) Figure 5 clearly shows overestimation of SWC by FDR, which has been reported by quite a lot of studies (e.g. https://doi.org/10.1016/j.agwat.2011.09.007)

L195. How the relative error is calculated should be part of M&M section. Not in results.

L202. The dryer is the soil and the greater is the relative error.

L213. Once soil calibration is done, new calibration constants can be injected into the relations between SWC and the real
part of dielectric permittivity.. Clearly show how the recalibration is effectively performed, i.e; ; how soil-specific calibration coefficients are determined.

CONCLUSION

Refer to objectives of this study and answer the research questions.

Appendix A

L242. “calibration process is made during sample drying.” For clayey soils there is a hysteresis effect. Is calibration different when using the drying path compared to the rewetting trajectory ?

L258. Why are you not taking calibrated digital photo’s to estimate the dimensions by digital image processing ? You are already taking photos for the cracks (L270)

L221 Papet => “Paper”

Some other reflections

L38. *a soil-specific calibration may be required locally to determine the proper calibration of moisture versus dielectric permittivity constants*
Is it better to do soil-specific calibration directly on the dielectric permittivity response of the sensors (as you did) or -in case of FDR, on derived sensor output signals like “period average” (or travel time in TDR) which also includes sensor characteristics ?