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Interactive comment on "Soil moisture and matric potential – An open field comparison ofsensor systems" *by* Conrad Jackisch et al.

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We thank the anonymous reviewer 2 for his/her careful work on our manuscript and the constructive comments. We agree that complementing laboratory tests of field sensors under a large spectrum of environmental conditions and site specifications was highly desirable and that our data set can only provide one short-term reference under bare-soil site conditions. We also agree that a comparative analysis of the sensors is of cause necessary. This has been done and will be published. However, we consider the data set to be worth publication on its own to provide the community a basis for own analyses, re-calibration attempts and references for study-planning. As referee 3 summarised: *[. . .] the data will not allow for finding a "best" soil moisture measurement system. Much more important is the potential of this comparison study to make*

us aware of the large spread in the absolute values and the need in the individual calibration of these sensors to the specific soil conditions.

We will work out this finding more specifically in the revised version of the manuscript.

As a description paper of a data set we purposely limited the depth of analyses and conclusions to a minimum. This is also the reason for the limited number of references. If the editor shares the notion of extending the manuscript in this direction, we have plenty of material prepared.

Specific comments:

L15-16: Thank you very much for this suggestion. We agree, that the classification is somewhat artificial and blurry. In this respect, FDR is actually not referring to a frequency analysis of the TDR signal as in the cited paper by Huisman et al. (2004) but to the measurement of variations of the frequency of the electromagnetic sensing pulse by the soil. However, the difference between FDR and capacitive measurements remains quite unspecific, since the evaluation of the sensed signal is indeed not a direct frequency measurement. Since we agree that more precision about the actual measurement and signal evaluation technique is lacking in the soil moisture sensing community, we will revise the table and name the actual measurement principle where available. Unfortunately in many cases, the measuring principle is only roughly summarised in the sensor description. However, the discussion about the currently established but not very helpful classification of soil moisture sensing techniques is not scope of this manuscript.

L20-21: Thank you for pointing out the missing aspect of bulk permittivity and its influence on lower operation frequencies. We will include a sentence here in relation to L24.

L22-23: You are right that the technical issues could not be tested individually in our study. We will rephrase the sentence to point out that the sensing systems need to solve a series of technical issues in addition to the theoretical concerns and that we employed the sensing systems on a best-practice application basis for the comparison. Nevertheless, the contact of the probe with the soil is indeed a design and material issue of some of the probes. But you are correct that we did not specifically address this.

L25-26: We will revise the sentence. The probes differ in the integration volume of the measurement. E.g. the Imko Pico64 have a much larger sensing volume compared to the technically identical Imko Pico32. As you pointed out earlier, a change in bulk permittivity implies a change in the sensed volume too. These effects are usually not considered but become relevant in the sensing of progressing wetting fronts which can be seen in the reported data by stronger event amplitudes of the Pico64.

L27: We will change this awkward phrasing.

L40: The size of the instrumented part of the field is 14 m x 4 m as sketched in Fig. 2. We will extend the caption of the figure to highlight this. The surrounding field is much larger with grass about 1 m north and bare-soil conditions for more than 5 m in all other directions.

L57: As stated above, we will include a brief description of the measurement principle for each sensor system in the revised manuscript. To do so, we will extend table 1. The calibration is for all sensors the manufacturer's standard *universal soil* calibration. We will add this sentence to the description. We will discuss if a description of each sensor system in the text gives additional information to the extended table 1.

L64-67: Our initial hypothesis was that we can calibrate some sensors through the laboratory reference to gain some sort of "true" reference time series. For this, we selected some sensor systems which recorded plausible data in the field and to which we had best access to. The space for lab reference measurements was limited by the sample size.

L100: The sample volume is 15.7 L (L64) with about 0.3 m height and 0.26 m diameter. We will extend the information given in L64. Obviously, the sample volume (or the distance of the sensor to the sample ring) is not large enough to be insensitive to boundary effects. However, the actual sensing volume with respect to the target state variable "soil moisture" of the sensors is in the range of some milli litres and at least 20 times below the sample volume.

Thank you again for your valuable comments and suggestions to improve our manuscript. We will consider your general comments in the revision to work out more details about the data, drafting possible analyses and highlighting the limits of the study along the lines discussed here.

References

Huisman, J. A., W. Bouten, J. A. Vrugt, and P. A. Ferré (2004), Accuracy of frequency domain analysis scenarios for the determination of complex dielectric permittivity, Water Resources Research, 40(2), 332, doi:10.1029/2002WR001601.

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