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Geoscientific Instrumentation Methods and Data Systems Discussions

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# *Interactive comment on* "Evaluating the suitability of the consumer low-cost Parrot Flower Power soil moisture sensor for scientific environmental applications" *by* Angelika Xaver et al.

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**Reviewer 1**

**General comments**

**I found the manuscript really interesting and pleasant to read. My major concern regards the calibration of FP sensor (par. 3.1).**
**According to what I understood, the Authors took only one soil sample, divided it in 5 parts, with different degrees of sauration, and procedeed to a comparison between the measures of soil moisture provided by 5 FP sensors and 1 profes-**



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**sional sensor. The results of the calibration are depicted in Figure 3. Based on my experience on soil moisture data and measurements provided by professional sensors (TDR in particular) I find this approach particularly risky, in particular because the conditions of soil aggregation (macro pores and other) can strongly change from point to point, also in small scales. I suggest the Authors to elaborate the concept and stress the calibration paragraph, highlighting the need of a more complete (in terms of soil samples) comparison between the sensors. Somehow, I have the feeling that the differences reported in Figure 9 could be attributed to what afore mentioned. Morevoer, I believe the Authors should be more cautious in describing the obtained results in terms of soil moisture also because some errors could have been determined due to the difference in the spatial position between the FP and the professional probes. Indeed the Authors state that "The exact horizontal distance between the FP sensors and the professional probes is unknown...", and that it could be approximately 1 meter. Based on my experience, natural soils (not in laboratories) can present strong differences also in small distances, in particolare concerning the hydraulic conductivity.**

*Response:* We thank the reviewer for the positive feedback, we are pleased that we could attract his/her interest for our study.

We understand the concern about the calibration procedure, thank you for raising this point. In the following we want to clarify our approach and the drawn conclusions.

Indeed, we used one homogenized soil sample, divided it into five parts with different degrees of saturation and used five FP sensors to measure the soil water content. As a reference we did not use a professional sensor, but determined the exact soil water content gravimetrically (p.8, line 174). To evaluate the FP sensors in the field we

used already installed professional sensors, the TDT SPADE sensors and TDR probe ECH2O 5TM. We agree with the reviewer that soil conditions can vary from point to point, certainly at catchment scale and even at much smaller scales. Unfortunately, within the scope of our study it was not possible to conduct the calibration evaluation for multiple soil samples. Although this would have improved the reliability of the FP sensor in terms of absolute soil moisture values, some uncertainty would still have remained (soil conditions can still vary between the removed sample used for calibration and the soil where the sensor is installed in the field). Furthermore, the primary goal of our study was to evaluate the performance of the FP sensor in general, in absolute and relative terms, as not for all purposes absolute soil moisture values may be of highest interest. Of course, if the absolute amount of soil moisture is of interest and not only the relative one, we agree with the reviewer that site-specific calibrations are highly recommended. This recommendation is also included in our conclusions section on page 23, lines 509 to 510.

It is true and we completely agree, that soil conditions in the field can vary strongly even within small distances and consequently can affect the soil moisture measurements. We mention this on page 16, lines 346-349: “In addition, differences in the absolute water content can be caused by local variations in soil texture. Although the FP devices were calibrated for the dominant soil texture type present in the HOAL catchment, the conditions in the laboratory are ideal (e.g. homogeneous soil sample) and less perfect conditions with local variations in soil texture are to be expected in the field.” To elaborate on this we suggest to slightly modify this section to: “In addition, differences in the absolute water content can be caused by local variations in soil texture and formed soil aggregates. Although the FP devices were calibrated for the dominant soil texture type present in the HOAL catchment, the conditions in the laboratory are ideal (e.g. homogeneous soil sample) and less perfect conditions with local variations in soil texture and formed aggregates (e.g. even macro pores) are to be expected in the field.”

We also agree that the horizontal distance between the professional and the FP sensor can result in the observation of different absolute soil moisture values due to local soil variations. Previously we only implied this fact in the above-mentioned paragraph. For more clarity, we suggest to add the following sentence to the paragraph (page 16, lines 350-351): “This local variation in soil can also differ within the small horizontal distance between the locations of the professional and low-cost sensors and thus can also contribute to the deviation in absolute values between both devices.”

We hope that we could satisfactorily address the concerns of the reviewer.

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