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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Soil moisture sensor calibration for organic soil surface layers" *by* S. Bircher et al.

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Dear reviewer

We are glad to hear that you are considering our work as valuable and we would like to thank you very much for your useful suggestions on how to improve our manuscript. Please find below our answers (point by point) how we plan to revise the manuscript based on your comments:

REVIEWER COMMENT 1: Very interesting paper, useful for users, maybe too long as presented (some parts, describing details on samples, could be placed in appendix). ANSWER: We fully agree with you on the part regarding sample descriptions. As already replied to reviewer # 1 who had a similar comment, we will shorten Section 2 as

following: Third order subsections containing very detailed sample information will be integrated into the respective FMI and HOBE data sections (2.1 and 2.2). Furthermore, text parts not relevant to understand the work done in this study will be omitted. We considered the option of moving some of the information into an appendix, but then decided it won't be necessary as we believe it would not further improve the comprehensibility of this manuscript.

REVIEWER COMMENT 2: The results appear very coherent and robust (between lab and field, between samples and between instruments). The main concern is about when in practice must we use mineral or organic calibration curve? The transition between the two types of samples is not clear. You only present the results separately with an arbitrary threshold of 30% SOM. Page 463, you mentioned another limit of 10% SOM? There is unfortunately no direct analysis as a function of organic matter, only colors in Figure 2. In other words, for which SOM value (or range of values) the 2 calibration curves for mineral and organic soil match together? Maybe, an additional figure showing the transition between both curves could help the users? ANSWER: As defined in Section 2, page 454, lines 9-11, a layer is considered organic if the soil organic matter (SOM) content is greater than ∼30-35%. Thus, the here derived calibration functions for organic material should only be applied if SOM content is greater than 30%. Beyond this threshold the offset from the calibration curve for mineral soils is more or less stable. In case of the Decagon 5TE sensor we found that for mineral horizons (SOM% <30) the calibration functions for mineral soils provided by the respective manufacturers were only valid for samples with SOM contents below 10%. Above this threshold the data points (couples of sensor output-gravimetric sample water content) started deviating from the manufacturer calibration curve as a function of increasing SOM content (hence, resulting increase in bound water fraction and decrease in permittivity), Figure 2. Thus, for mineral soils in the SOM range 10-30% accurate calibration functions are currently missing. As we state in Section 5.1, page 463-464, lines 27-29 and 1-3 as well as Section 6, page 474, lines 1-3, at this point, we do not have enough data in this SOM range. However, if enough data were collected

in the future, one could attempt a calibration as a function of SOM content.

REVIEWER COMMENT 3: Discussion (comparison?) with the Mironov's model should have been interesting. ANSWER: Indeed, a comparison with the Mirinov's model would be interesting. However, since the paper is already long and includes comparison with a wealth of calibration functions for organic substrate reported in literature, we did not want to involve dielectric mixing models as well. But we are preparing another manuscript on measurements of relative permittivities of organic soil surface layers at the L-band (1.4 GHz) frequency and intend to include a comparison with the Mironov model there.

REVIEWER COMMENT 4: Form: In the text describing the Figures, try to give the corresponding symbols and colors used in the figures. This will make easier to follow what you speak. ANSWER: We agree with your comment and will include the corresponding colors and symbols throughout Section 5.

REVIEWER COMMENT 5: In Figure 4: explain the green curves? ANSWER: Thanks for your remark and sorry about that – we already noted after submission that the second part of the legend must have gotten lost somewhere. It will of course be included in the revised version of the manuscript.

REVIEWER COMMENT 6: We did similar measurements with a similar protocol and with the same sensor (Decagon 5TE) and also with another Decagon sensor GS3. Our sample comes from James Bay area (boreal – subarctic post-glacial soil type). Unfortunately, we don't know the SOM? The results (Fig. R1) of this limited analysis (only one sample and 2 sensors) show, as expected, that the calibration curve depends upon the type of sensor used (GS3 vs 5TE). The comparison against the results from the new proposed curve (red line "Bircher") shows in Fig. R1 that our sample should be more mineral than organic? This outlines the fact that the transition between more or less organic matter amounts is important. ANSWER: Thank you for sharing your interesting study! Nice to see that the different practices lead to the same result in

case of both sensor types. Would it at all be possible to define the SOM content of your sample? From the figure it looks like this soil is possibly in the range of 10-30% SOM, so knowing the actual SOM content, one could maybe use these data to attempt a calibration in this SOM range. (see our respective comments above). Regarding the GS3 sensor type, we would be very interested in learning from your experience as we are planning to install the same sensor type shortly in a similar environment in Siberia.

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 5, 447, 2015.