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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Calibrating electromagnetic induction conductivities with time-domain reflectometry measurements" *by* Giovanna Dragonetti et al.

G. Cassiani (Referee)

giorgio.cassiani@unipd.it

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I have found the paper interesting and potentially worth publication. However I find it somewhat surprising that the authors seem to believe that TDR is a better method than EMI to measure electrical conductivity. This seems to be an assumption made a priori, and not supported either by the scientific literature nor by any evidence in the paper. EMI is designed specifically to measure electrical conductivity, while TDR is designed with the measurement of dielectric properties in mind. Using TDR also to measure electrical conductivity can be done, similarly to using attenuation in GPR measurements to do the same. However it is not a recommended approach. My suggestion to

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the author is to reverse the line of reasoning, believe more in EMI (with some caveats especially concerning the depth of investigation) and rather question TDR as a method for sigma measurement. In a nutshell, give more credibility to geophysics and question some belief in soil science. To this end, I also suggest that an eye is given to ERT as a technique that can provide ground truth much more reliable that TRD for electrical conductivity (see e.g. Cassiani et al., 2012 and Ursino et al., 2014, but many other papers deal with the EMI-ERT obvious relationship). I am also very surprised that moisture content estimates from TDR are not considered at all in the paper – yet the data must be available. I suggest the authors present also those (much more solid, I presume) data. I encourage the authors to revise the paper along these lines and resubmit this potentially interesting dataset. Line 26: "contributing to enhance the spatial resolution of the EMI reconstruction". I am not sure one can claim that the use of a stabilizer (how much needed would also require a specific discussion) truly enhances spatial resolution of a geophysical method. In my opinion this statement is wrong. I suggest a reformulation here. Line 35: "after filtering the TDR data." Even though this is the abstract, the statement is far too generic. Details about the filtering approach shall be briefly given here. Line 125: "Then we assess the quality of these reconstructions by using TDR data as ground-truth." This is a very brave statement. I do not see TDR as any more reliable to measure sigma than EMI, indeed quite the opposite. Line 132: "Accordingly, the paper provides a methodology to calibrate EMI results by TDR readings." This should not (cannot) be the focus of this paper. If the authors believe this is a viable strategy, I totally disagree. Line 291 and following. Spending time describing Fourier transformation is probably useless. Rather, I would concetrate on describing in detail what type of filtering is applied. "Fourier filtering" is unclear. I presume it is a spatial filtering made to enhance the long wavelengths? Please be more specific and try and link the approach to established (there are far too many) filtering techniques. Line 573: "Ferre" is actually "Ferré" Line 727 Figure 2. "Examples of sharp and smooth inversions applied to the same dataset 100-6dS. The results are shown together with their corresponding data misfit". I see only one curve of data misfit. Does it refer to

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both sharp and smooth inversion? Also, I find it a bit difficult to justify in the images how some dark blue areas in the smooth inversion indeed correspond to slightly less dark blue areas in the sharp inversion. I am also a bit skeptical of the fact that using an EM38 one can image with confidence to a depth as large as 3 m! Line 735, Figure 3: here too some details about the filter applied to the TDR data shall be given. It is not acceptable that in a caption only the term “filtered” is applied. One can use any type of filter! The same applies to Figures 4 and 5

Figure 6: the difference between TDR and EMI measured sigma is quite large indeed. Overall I am not sure that TDR is the best method to measure sigma. Indeed it is not. TDR is the chief approach to measure dielectric properties.

Figure 8: the difference between the two images is striking. I am not sure how the authors are so confident that the correction applied to obtain the revised EMI image is correct. References Cassiani G., N. Ursino, R. Deiana, G. Vignoli, J. Boaga, M. Rossi, M. T. Perri, M. Blaschek, R. Duttmann, S. Meyer, R. Ludwig, A. Soddu, P. Dietrich and U. Werban, 2012, Non-invasive monitoring of soil static characteristics and dynamic states: a case study highlighting vegetation effects, Vadose Zone Journal, Special Issue on SPAC - Soil-plant interactions from local to landscape scale, August 2012, V.11, vzj2011.0195, doi: 10.2136/2011.0195. Ursino N., G. Cassiani, R. Deiana, G. Vignoli and J. Boaga, 2014, Measuring and Modelling water related soil – vegetation feedbacks in a fallow plot, Hydrology and Earth System Sciences (HESS), doi:10.5194/hess-18-1105-2014.

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