

Interactive comment on “A soil non-aqueous phase liquid (NAPL) flushing laboratory experiment based on time domain reflectometry (TDR) and modeling” by Alessandro Comegna et al.

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Dear Referee #3,

With reference to the paper: hess 2019-149, by A. Comegna et al., please find below the replies to your review. The authors would like to thank you for your comments on our paper. We would like to say that part of your observations have been resolved in the revised version of the manuscript, in accordance with those of the other two referees. 1. That said, we would like to stress the fact that the purpose of this study

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was to investigate a possible extension of TDR technology to assess the effects of NAPL removal in soil organic mixtures, “in real time” during a decontamination process. As is well known, TDR is one of the most important geophysical methods, with its first applications in Soil Physics in 1980 (see Topp et al., 1980). In recent years several efforts have been made to extend the use of TDR technology. See for example Kachanoski et al. (1992) who employed TDR for measuring in the “soil” the presence of a leaching solute. With direct reference to TDR-NAPL applications, most studies have demonstrated the potential of the TDR technique in estimating NAPL presence in saturated soils (Redman and DeRyck, 1994; Chenaf and Amara, 2001; Haridy et al., 2004; Mohamed and Said, 2005; Moroizumi and Sasaki, 2008). Some experiments have been conducted on unsaturated soils (Persson and Berndtsson, 2002; Rinaldi and Francisca, 2006; Francisca and Montoro, 2012). In these studies, the estimation of NAPLs using TDR measurements of dielectric properties has relied greatly on various mixing models relating the measured dielectric permittivity to the volume fractions of the pore fluids and various soil phases such as solid, water, air, and NAPLs (van Dam et al., 2005). Finally, I would like to recall the papers of Comegna et al. (2016) and Comegna et al. (2017) which tackled the problem of NAPL detection in variously saturated homogeneous and layered “soils”, respectively. 2. As already stated in the manuscript, the range of model applicability is: $0.15 < \theta_{\text{NAPL}} < 0.40$. At $\theta_{\text{NAPL}} = 0.05$ and 0.10 , TDR is not sensitive to NAPL volumes. 3. The present research is a first attempt to monitor via TDR the dielectric response of an NAPL-contaminated medium during a decontamination process. Thus we chose a simple initial scenario to avoid possible dielectric “interferences” related to other phases. This aspect could be explored in further research. Sincerely The authors

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