Reply to Referee #2:

General comments

Reply: We would like to thank the reviewer for their evaluation and constructive comments, which definitely helped to improve our paper.

1. The term 'effective hydraulic properties' is used in the paper. What's the difference of effective hydraulic properties and hydraulic properties?

Reply: Commonly, we quantify soil hydraulic properties for a small soil sample and implicitly assume homogeneity within the measured volume. However, soil heterogeneity may become non-negligible when the scale of the measurement volume is increased. Particularly, this is required for the analysis of natural sediments. Thus, effective hydraulic properties are used to define the heterogeneous soils. In this study, we focus on the hydraulic properties at plot scale where soil heterogeneity does exist. Therefore, we refer to effective hydraulic properties.

2. Page 5 Line15: For the bottom boundary, a Dirichlet boundary condition is applied with a fixed water pressure of -0.4 m. Page 9 Line12: The lower Dirichlet boundary is constantly set to the position of the water table inferred from drilling (-1.7 m). Please explain the bottom boundary. Is 'a fixed water pressure of -0.4 m' a good assumption? How will this assumption affect results?

Reply: Thanks for pointing out this mistake. The two numbers originate from different references. The measured water table inferring from drilling is 1.7 m below the ground surface and the height of the 2D geometry model is 1.3 m. Hence, the water pressure at the bottom is set as -0.4 m (1.3m - 1.7m). To keep consistence, we revise it in Page 9 "The lower Dirichlet boundary is constantly set to a pressure of -0.4 m in consideration to a water table of 1.7 m below ground surface inferred from drilling.".

Since our experiment was conducted on farmland, we didn't have in-situ monitoring. Thus, we set the bottom boundary condition as a fixed water table. We acknowledge that this assumption can bring some uncertainties in water content distribution in the simulated domain, because the water table may have varied in time and space during the observed period. However, the inversion mainly relies on the information from the upper layer. Besides, we know from a synthetic study that the sensitivity of the parameters of the first layer typically surpasses that of the bottom layer by two orders of magnitudes. Therefore, although the simplification of the bottom boundary condition increases the structural errors, we decided to neglect this source of uncertainty in a first step.

3. Page 14 Line19: Particularly, the structural information resulting from the slope-induced lateral water redistribution is essential to the proposed approach. Page 16 Line15: Application of the demonstrated approach mainly relies on the slope gradient of the undulating structure and the lateral water redistribution. A 2D model is used here to simulate lateral water redistribution. If a 3D model is applied here, the simulated lateral water redistribution may be more or less different. How do you consider this?

Reply: The advantage of 3D model is that more lateral water redistribution information can be captured and the conversion error from 3D to 2D can also be avoided. However, from the GPR data of the material interface suggest, that the main slopes contributing to the lateral flow can be well approximated with a 2D model. Thus, in this study, we focus on the general proof of our concept using the 2D model. concerning the expensive computational cost of 3D modelling,

please also note the answers to the comments 3 and 6 of referee 1.

4. Page 9 Line6: For the hydraulic model of the transect, the geometry (16.82 m x 1.3 m) is discretized with a resolution of 0.10 m x 0.05 m (Fig. 3b). Page 13 Line4: Three two-layer architectures (S1, S2, and S3 in Fig. 6) are employed with a domain of 6.28 m x 2 m and are discretized with a resolution of 0.04 m x 0.02 m. Two different models are used instead of one, please explain.

Reply: The two models were designed with different goals in mind. The geometry of the field study is given by the field site. In order to minimise the computational cost for the analysis and the parameter estimation, we decided to decrease the resolution of the model.

The synthetic study was designed to analyze the possiblities of the presented approach, once very favourable conditions are met. Thus, we decreased the domain size and increased the resolution of the model.