Interactive comment on "Saturated and unsaturated salt transport in peat from a constructed fen" *by* Reuven B. Simhayov et al.

Anonymous Referee #1

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Hydraulic as well as solute transport properties of peat soils are still poorly understood as compared to mineral soils. In their study the authors address both hydraulic properties and solute transport parameters. Unfortunately, none of the mechanisms is considered with the necessary depth to reveal new insight. The paper suffers from the treatment of too many different processes and employed methods. Moreover, an unjustified experimental approach and shortcomings in the model evaluation do not allow drawing definite conclusions.

The paper shall not be published because of a confusing number of considered aspects. A re-consideration of the manuscript makes sense only if additional experiments are conducted and/or emphasize is laid on either hydraulic properties or solute transport conditions and if the model evaluation of solute transport data is revised.

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Discussion paper

1. Characterization of peat samples: Peat soils are divers as mineral soils. Their exact characterization is crucial to classify any experimental outcome. I couldn't find any basic characterization of the investigated soil, even not the organic matter content nor the Van-Post value. Moreover, the peat is characterized as sedge peat, but Figure 1 shows moss with hyaline cells. Peat structure is a fundamental element of the study because it determines hydraulic and solute transport properties to a great extent. 2. Experimental approach: (i) The authors aim to reveal the hydraulic and solute transport properties of a fen peat. They point out that the investigated soil did not exhibit any (structure-related) bi-model behaviour, neither in the soil water retention function nor in the solute breakthrough curve. The conclusion drawn is unjustified because soil structure was compromised upon sample preparation (sieving and re-packing). Relevant and recent studies clearly showed that plant residues (embedded in an intact peat structure) in undecomposed peat may serve as a preferred solute pathway (Liu and Lennartz, 2015; Liu et al., 2016). (ii) Peat soils differ from mineral soils in their ability to retain compounds that are generally considered as "conservative" or inert such as chloride anions (Hoag and Price, 1997; Caron et al., 2015). It has been likewise observed that the application of sodium-chloride to peat samples may cause a rearrangement of pore structure based on a pore dilation effect (Ours et al., 1997). Both aspects shall be discussed in a publication on sodium-chloride transport in peat soils. 3. Model evaluation: The authors employed the mobile-immobile solute transport concept and the according solution of the underlying equations to obtain parameter values by running optimization algorithms. From a huge body of literature (for instance Parker and van Genuchten, 1984; Bond and Wierenga, 1990; Gao et al., 2009) it is evident that the simultaneous optimization of the pore water velocity (v) and the fraction of immobile water (β) may lead to invalid parameter values because both parameters account for the position of the BTC on the (dimensionless) time axis. Keeping v fixed at the measured values would probably have produced a different outcome and a different conclusion. In this context, the possible retardation of the "conservative" tracer needs to be considered (see above). In its current state the discussion of the obtained

parameter values is poor. For instance, how can it be explained that the optimized pore water velocity (v(fit)) showed greater values than the measured (v(measured)) employing the (single modal) convective dispersion equation? A ratio of v(measured)/v(fit) of less than 1 is a clear indication of a preferred solute transport situation. 4. Additional comments: There are several additional issues with the manuscript. Solute concentration data shall be presented against exchanged pore volume instead of absolute time to better classify the breakthrough behaviour. The result section starts with the presentation of the (adjusted) bulk density etc. That clearly belongs to Material and Methods. There are likewise some editorial flaws: Doubling of sentences, etc. (lines 101-104). At this stage, however, it doesn't make sense to give a complete list of minor issues because the study and manuscript have to be completely revised anyway. 5. Suggestion: There is some potential in the work. It is, for instance, interesting to compare saturated and partially saturated solute transport scenarios. It is likewise valuable to combine transient evaporation with tension disk measurements to obtain soil water retention and hydraulic conductivity information. To my knowledge, that has not been done before with peat soil samples. In any case, the experimental data base needs to be substantiate addressing the given points to draw definite conclusion. The study could be substantially upgraded if data from UNDISTURBED samples could be presented in comparison to the data from the disturbed samples. This holds true for the solute transport as well as for the hydraulic properties alike.

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