Hydrology and
Earth System
Sciences
Discussions

Interactive comment on "The effect of initial water distribution and spatial resolution on the interpretation of ERT monitoring of water infiltration in a landfill cover" *by* Gaël Dumont et al.

Anonymous Referee #2

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Dumont et al. present a case study of 2D-ERT profiling of a municipal solid waste landfill (cover) for investigating "the effect of a major rainfall event on water infiltration", as well as "synthetic case studies to investigate the interpretation" of the field ERT data that comprise a "sand box experiment" and unsaturated flow simulations with Hydrus 2D. The combination of field methods, laboratory measurements and simulation-based identification of possible multiple pitfalls is promising, or rather essential in order to reduce the inherent equifinality. However, the presented combined approaches, lacking usual ground truth measurements and representing very simple models do not lead to

a deeper understanding of the case study site, but allow for highlighting general pitfalls and limitations of ERT interpretations. Interestingly, the authors highlighted the general challenge of inhomogeneous background water content that may considerably affect patterns of relative changes of ER. Disregarding that the current version is somehow damaged (missing/doubled sections), the manuscript might confuse the reader. Reasons are the mismatch between a (coarsely) motivated field study that present insufficient data to meet the authors aims and the investigation of general aspects/limitations that would benefit from more realistic scenarios (material properties, geometries, structural aspects). Overall, the manuscript requires improvements in structuring, adjustments of the addressed aims and conclusions and completion of descriptions of experiments and data processing. Generally, credit to related literature/studies appears to be insufficient so that the contribution to scientific progress and novelty is hard to assess.

Abstract: The time-lapse aspect is a little missed out, by presenting one pre-event and one post-event pseudosection only. Thus, the explicit mention is questionable. In the manuscript, data and discussion is missing for assuming the observed infiltration as being "responsible for an important part of the annual water infiltration".

Introduction: The introduction starts very general and noncommittal. It would be helpful for the reader to introduce "bioreactor landfills" as monitored systems with their overall use and challenges (e.g. enhancement of biodegradation by maintaining moisture and oxicity conditions). Operation practices and possible needs for optimization might be cited. P2, L3: The reference to other methods for WC measurements is very vague and lacks already applied methods in bioreactor landfill monitoring. The authors might help he reader by detailing the multiple controlling factors of ER, such as porosity, pore water chemistry, temperature, mineralogy, ..., structural factors (e.g. soil compaction). The complete mention of target media of (physical) parameters is often omitted (e.g. P2, L4-9). Generally, the introduction hardly identifies the lack of knowledge in a persuasive way. The study aim "highlight and quantify the effect of limitations of field ERT data for

waste management" is ambitious and possibly deserve a more comprehensive review of related studies. The term "sand box" experiment is mentioned in the introduction but never again. The consistency of terms should be checked. The manuscript contains incomplete (P3, L4) or doubled paragraphs (P8, L15 to P9, L27) and typing and tense errors.

Material and Methods The authors should detail the composition of the landfill and cover (soil-like or rubble) at the beginning. Why is it important to mention the inertness and what does it mean? Why is the saturated zone not covered in the ERT measurements/sections? A locally differing cover layer thickness is mentioned but not detailed. The characterization of the 3 "soil conditions" is very vague, lacking qualitative and quantitative data for the mentioned parameters. P4,L6 possibly name the application of a pedoelectrical model that should be explained in detail. The authors estimated the pore fluid conductivity by applying a batch experiment with cover material from shallow depths and deionized water. Both the experiment type, usually destroying soil aggregates (possibly higher release of solutes) and the used liquid (increased dissolution) possibly differ strongly from the process of leachate formation by rain infiltration. The discussion of correlated changes in vegetation and texture is not convincing due to the lack of measured parameters and sampling design. P5, L5: The authors limit the focus to the landfill cover, while neglecting the characteristics of the waste. I assume that operators are usually interested in internal flow patterns in the heterogeneous waste, rather than in the obvious effect of fine-grained and coarser grained cover material. The relationships between electrical resistivity, water content, subsurface temperature and petro-/physical parameters are usually determined by laboratory experiments. Generally, lacking of independent soil moisture measurements does not allow for reliable relationships between resistivity and water content. Thus, it is unclear to me, why the authors did not conduct measurements of temperature and water content that are likely common practice in ERT studies. A detailed description of the used electrode array configuration and ERT system (device) is missing. As mentioned, the authors used a difference inversion procedure without commenting on this selection and with-

out giving details of the inversion algorithms. To calculate water contents from ER data, the authors applied Archie's law. Regarding the cover material ("sand, silt, loam"), it was not adequately verified that this pedoelectrical model is suited. The laboratory experiments ("sand box" experiments?), named in P6, L10 are very coarsely reported, lacking adequate data presentation. If already presented in Dumont et al. (2016), the authors should not give a short version here, but clearly refer to the already published contents. Reported permeabilities (e.g. P7, L8) do not fit to the units that likely represent hydraulic conductivities. The M&M section lacks the description of the sand box experiment and a clear differentiation between measured and calculated parameters. I wonder why the authors did not use the landfill and cover material for their laboratory experiments.

Results and Discussion Regarding the number of presented pseudosections, it is unclear to me, if an independent inversion that is more prone to artefacts was carried out, or a more complex inversion method. P10, L18: Possible multiple factors for initial resistivity contrasts are not explained satisfactorily. The central anomaly was attributed to inversion artefacts. The authors should be more informative here, as well as in P12, L21 and P15, L10. Causes of the "strong inversion artefact" should be identified. Large sections are cited verbatim from Dumont et al. (2017) (e.g. P11, L2; P14) and thus indicate possible conflicts. P12, L3: The parametrization should not be assumed to represent the field conditions due to the lack of field measurements and assumptions made. P12: The authors should explain the meaning of "smooth/smoothing". P14 and Fig.7: Listing of hypotheses and abbreviations is fragmentary. The challenges and approaches that are mentioned in P14, L5 to L11 are very general and not surprising. Throughout the manuscript, the authors did not explain why they omitted ground truth measurements of water content, texture/structure of cover materials and waste, layer thicknesses etc. Given the fact that there is a separate discussion section, the presentation of results and discussion is overall blurred. The same holds partly for conclusions. P15, L15: It is unclear if the authors suggest a contribution of uphill generated runoff (internal or overland flow?) to explain the field data or if they reject the

modelling results. They should report their observations during the event.

Conclusions: P16, L12: The authors concluded that ERT was successfully applied to indicate water infiltration but without quantification due to missing data of pore water resistivity and dilution. The reader would likely expect conclusions on theoretical and practical progress in the framework of bioreactor landfill monitoring. P16, L5: The reference to tracer tests is unclear to me. The last concluding remarks (P16, L16) are a very vague attempt to relate the results and overall scope of the study.

Figures: Fig.1: I suggest improving figure 1. The geometry of the landfill is unclear (borders, show level contours!) and thus the location of the profile is not assessable. Usually figures are presented in the order from regional to local maps. The authors may use GIS and a vector graphic program to create figures. Data sources (i.e. aerial image) are missing. Fig.2, 3, etc.: x-scales are missing.