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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Exploring the regolith with electrical resistivity tomography in largescale surveys: electrode spacing related issues and possibility" *by* Laurent Gourdol et al.

Anonymous Referee #2

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This manuscript presents an original study on the impact of electrode spacing (ES) on the resolution of resistivity models resulting from Electrical Resistivity Tomography (ERT) surveys. The study is illustrated by a series of synthetic data through forward modelling and by one field case study at the Weierbach catchment in Luxembourg. I must say, the technical aspects of this paper are excellent. The authors have used a state-of-the-art methodology and most of the processing steps of the ERT data, both for the forward modelling and the inversion, are relevant and well explained (sometimes too much). In fact, this is a very good technical paper. However, the research question is trivial and the proposed updated methodology is somewhat questionable. The authors even mention in the abstract that (most of) the findings are obvious (!).

Decreasing the ES, will indeed result in a greater resolution of the resistivity model, no doubts about that. Now, this paper has the merit of documenting very well the effect of different ES via a synthetic case study (Fig 3 is a great one for teaching purposes for example), and to illustrate that decreasing the ES has also an effect on the precision of the retrieved boundaries at depth (which is potentially the most interesting outcome of the paper). But then the next question is: is this paper suited for HESS? I am not too sure, since it proposes a slightly questionable updated methodology for ERT measurements done on sites with very specific characteristics in terms of homogeneously flat soil/geological structures, and for those interested to image both the thin soil layer and deeper structures. I don't see that this falls into the scope of HESS to be honest. Sure the authors have oriented the introduction on the benefits of ERT for hydrological investigations, but the rest of the paper does not really matches with HESS at this stage, even when discussing the right way of estimating precise depths of boundaries between deeper layers. I think that the methodology would be more suited for publication in a more technical journal on applied geophysics, potentially focusing primarily on the synthetic modelling. And then perhaps, building up on the published methodology, the authors could demonstrate its benefit for hydrological purposes through a real case study. But again, the technical aspects of this paper are outstanding.

Specific comments

My understanding of the proposed methodology is that it works on a site with a configuration of "conductive / resistive / conductive" three-layered structure, with a shallow layer "homogeneous in terms of resistivity and thickness." The authors propose to survey long profiles with large ES and smaller profiles with a smaller ES. And then, add some interpolated data points for shallow levels of apparent resistivity in the datasets of the long profiles. This is a bit tricky since it includes potential biases in the dataset of the long profile and poses questions in terms of spatial interpolation between smaller profiles and long profiles. Moreover, if you know that the shallow layer of your site is already homogeneous in terms of resistivity and thickness, what is the point to survey

the site? And if it is actually not homogeneous, there is a great chance that this method will virtually tell you that it is, which is more problematic. It is also not clear what is the interpolation approach used in the method. Are the authors simply extracting a mean value for different depth levels of apparent resistivity and include that in the large ES datasets as a series of virtual quadrupoles along the profile with the corresponding depth level of apparent resistivity, or are the authors spatially interpolating the apparent resistivity of several small surveys with small ES into the large ES datasets? I think a diagram explaining the methodology would be highly beneficial for the reader to understand it a bit better.

Descriptions of the synthetic results are a bit confusing, especially in section 3.1.1 which describe a lot of figures and tables (both in the manuscript and in the supplementary materials), which elongates the reading of the manuscript a bit too much. In fact, I think there are too much scenarios and results to describe for a paper. I would rather suggest the author to focus on a couple of scenarios to simplify the text.

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