Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-450-RC3, 2016

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Flow dynamics in hyper-saline aquifers: hydro-geophysical monitoring and modelling" *by* K. Haaken et al.

Anonymous Referee #3

Received and published: 13 October 2016

The paper addressed the application of time-lapse crosshole ERT imaging to monitor the injection of freshwater into a hypersaline aquifer. In addition, a coupled numerical flow and transport simulation was performed to produce synthetic ERT data that were later compared with field data. The work is within the scope of HESS journal since the problem was dealt in a multi-disciplinary manner. Moreover, this study may contribute to understanding complex saline-freshwater interactions, specially in the context of freshwater storage within brackish or salty aquifers.

The overall presentation is very good, the language is fluent and easy to read. The used methodologies were correctly applied and authors demonstrated a deep knowledge about it. In fact, I consider that applied methodology is proper to this kind of problem. The title clearly reflects the contents of the paper and the abstract provide a complete summary of the study. In addition, the experiment is sufficiently described

to allow reproduction. The methodology, results and discussion are supported by high quality bibliography. In general, the structure of the article is good but it seems that many results are included within the methodology. I suggest to move all the results to Results and Discussion section. Below, the part that should be moved:

173-182: This is the result of a measurement. I suggest to move to result section. 233-238: the results of sensitivity analysis should be moved to results. Also Figure 5. In addition, what electrode configuration (dipole-dipole, bipole-bipole) does sensitivity distribution refer to? (229-238) 258-293: These are the results of time-lapse ERT imaging. Move to results. Moreover, to support the statements regarding the sensitivity of different electrode configuration, both (dipole-dipole and bipole-bipole) senstivity analysis may be provided in figure 5. 288-289: Why resistivity background image does not "detect" the layer of finer sediments. Likely, the high water conductivity masks resistivity variations due to lithology. But this fact should be addressed. 276-277: What is the explanation for "only a gradual change to higher resistivities in the upper part just below the water table can be seen"? Why the transition zone has this large thickness? Since the sediments above water table are mainly within sand fraction, the influence of capillary zone should be negligible. What is the water content of the unsaturated zone? 362: This sentence is part of the results. 371-387. These paragraphs, with their respective figures, should be moved to results.

Some other comments:

369-371: How were the hydraulic conductivities of the different scenarios selected? Were they manually calibrated? Please, clarify.

477-478: "Considering the extreme salinity observed at the site, this is not surprising". I'm not sure about the validity of this affirmation. In fact, Archie's law better describe electrical conductivity-salinity relationship in saline to hyper saline conditions. Perhaps, the choice of a unique formation factor (F) value is one of the reasons for the total mass underestimation by ERT field data.

Figures: Fig. 2. The patterns in the lithology channel should be more contrasting. Please, make wide the line in the Fine fraction, porosity and electrical conductivity logs. Fig. 3. Please, change the symbols for different conductivity logs. The same for Fig. 13 Figs 7, 10, 11 and 13 should be enlarged.

Fig. 10: Why do x-coordinates for modeling results differ from those in figs. 7, 11 and 12? The coordinates should be the same? In relation to this, the 3D mesh in Fig 8 should include coordinates and the position of boreholes.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-450, 2016.