Review of the paper „ Hydraulic properties at the North Sea island Borkum derived from joint inversion of magnetic resonance and electrical resistivity soundings“ by Günther and Müller-Petke

This paper combines a methodical development and an interesting case study. The authors developed a joint inversion algorithm for the magnetic resonance sounding (MRS) and vertical electric sounding (VES) data and applied this algorithm on MRS and VES data observed on the North Sea island Borkum. In addition to the derived model parameters (water content, decay time, resistivity), they have predicted the porosity and hydraulic conductivity of the survey area by using pumping test data to calibrate petrophysical relationships.

On the whole, the paper is easy to follow and well organized. Unfortunately, some details of the developed joint inversion technique are not presented. This is due to the fact that the authors combine two different topics (joint inversion algorithm and derivation of petrophysical data) in the same paper.

In the following, I list some suggestions/ questions to improve the paper. They include mainly the modifications of some figures. Nevertheless, I request that the authors should explain the necessity of the joint inversion by comparing the result with the single inversion. The paper can be published after some minor corrections.

1) The title is misleading. In general, without borehole information about the calibration factor which is used in Eq. 6, hydraulic properties cannot be derived from the joint inversion of MRS and VES data alone. This fact should be mentioned in the abstract and in the conclusion part.
2) I am wondering why Mr. Liebau is not a co-author of this paper. He has measured the MRS data and also interpreted them in his thesis. I also miss a comparison of his inversion results with the results of this paper.
3) The authors argue that the joint inversion significantly improves the reliability of the results. Again I miss a comparison with individual single inversions. Where is the improvement ? In addition, there is no information whether the authors use a weighting between the methods in their joint inversion. If they did, how ? If they didn’t, why ? I would also suggest that the developed joint inversion algorithm should be applied first of all on synthetic data. I am sure that the authors did it, but they did not show it in this paper.
4) The difference between the joint inversion algorithm of Vouilamoz et. al. (2007) and the algorithm presented in this paper should be more detailed.
5) What is f in Eq. 1?

6) The amount of layers is relative clear by visual inspection of the VES curve. Why are you then starting with a homogenous halfspace ?
7) Fig. 1 should be improved. The location of the VES and HEM stations are not visible. Please write also the name of the MRS stations on the map.
8) What is the vertical electrode chain ? Is it a different name for the VES? Unfortunately, the reference about it is an extended abstract and I could not find it.
9) Fig. 2: Write the name of the structure on the lithological map. It is not necessary to display so many curves showing the same information in Fig. 2c. At least HEM (L=19) and VEC can be deleted. Fig. 2b is interesting but not relevant for this paper.
10) Please define error weighted misfit.
11) The conductive layer (clay) in 20 m depth is not resolved by the water content and the resistivity. As also demonstrated in Fig. 3, the error bounds are too large. There is also no indication of this layer on the apparent resistivity curve. Why did you choose a 5 layer model in Fig. 3 which is not visible on the apparent resistivity curve? The resolution of a thin conductive layer is also a well known phenomena of the resistivity method. I am wondering why this layer is displayed in the resistivity inversion model. Please write the units for Fig. 2, 3, 4, 5d.
12) The authors state that the joint inversion improves the resolution and therefore decreases uncertainties (p. 2815). In order to prove this statement, I would expect a sensitivity analysis of the single inversion and a sensitivity analysis of the joint inversion and then you could compare the single and joint inversion's improvements of importances .