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Hydrology and Earth System Sciences Discussions

Interactive comment on "Quantifying freshwater resource in coastal barriers: the joint use of transient electromagnetic and magnetic resonance soundings" *by* J.-M. Vouillamoz et al.

Anonymous Referee #3

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The presented discussion paper deals with the aim of quantifying hydraulic properties of a barrier island that is possibly threatened by climate change. It is therefore suited for the journal in general and the special issue in particular, although links to the other papers in the latter, with sometimes very similar geophyical methods in fresh-salt water systems, are unfortunately missing.

The paper starts with the methology of deriving groundwater resource parameters and geophysical methods before explaining the experiments and their results. The methodology of using a combination of TEM and MRS is goal-oriented since the measured

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parameters lead to aquifer properties, e.g. water content and resistivity to fluid salinity. Moreover, measurements at different times provide some insight into the temporal behaviour of the interface, although the sea-river system is probably far too complex to be understood by a few soundings alone.

General comments

1. The title suggests not only freshwater resource but also hydraulic properties

2. Instead of a sequential inversion of the data, a coupled or joint inversion as presented in several papers could further reduce ambiguity in the model and parameter uncertainty. Please make clear statements about existing works and justify why your approach is sufficiently valid. Main point in your case is the high sensitivity of TEM to the salt-water interface but stating "no equivalence" to the method is not correct.

3. Synthetic modellings (sec. 2.3): Are the synthetic data contaminated with noise as usual and crucial? The resulting RMS is not necessarily a measure of the quality of the inversion result but is expected to represent the added noise. As there is a known equivalence of resistivity and thickness in TEM, 5269.3-4 is wrong, at least it is better for MRS (line 7) but there is always equivalence so that line 20 is wrong. The actual numbers (lines 19-24) depend on the noise level. The whole subsection lacks from a technical point of view and would mislead hydrologists. References for the statements will be needed, there are some in MRS literature.

4. The interpretation of the temporal behaviour of the aquifer is in my opinion rather speculative and can probably not be answered by the presented data alone, e.g. further non-geophysical temporal data would be needed to prove the hypothesis that infiltrated water does not change the salinity interface.

5. Figure 9 is weird and does not add anything to your story. Moreover it seems to imply that CVES data are useless in this case but several papers have shown the contrary. Figure and according text should be deleted from the paper.

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Specific comments acording to page and line number

5263.24 groundwater is not a factor

5263.25 parameter->parameters

5263.27 direct or close

5264.02 which pore-size parameters

5264.5-7 there is a long reference list, as most are only cited here it should be shortened to essentials

5265.4 the statement of 50m is far too general, the investigation depth here is strongly determined by the saltwater

5265.12 which parameters?

5265.22 bound and capillary water cannot be measured by MRS as the sentence suggests

5266.8-11 either specify units for input and output values or give C_T (often C_p) units

5266.24 give references for the specified m values

5267.6 since eq. (3) uses water resistivity

5271.22 clarify what exactly you mean. As you know resistivity from TEM, the magnetic fields can be correctly computed and should be.

5271.27 give some actual numbers of S/N

5272.14 27 percent seems to be a bit low for the given lithology

5272.16 why did you use 5 layers? 3 or 4 would be definitely enough. Keep it as simple as possible

5274.4 the m value of 1.3 does not suggest anything about MRS, reformulate

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5275.2+5 the referred equation should be (2), not (1)

5277.3 this section could better be called Discussion

5277.15 a linear gradient of conductivity makes more sense than of resistivity

5277.26 CS is not a usual abbreviation, FDEM sounding suits much better

5277.8-10 this holds only for the EM34, not for FDEM in general

References

only 1 reference of the special issue is cited, although more would suit well

5280.18 add spaces around -

5283.7 insert comma after title

5283.15 Simeon->Simon

Figures

Fig. 5 A 3-layer model would suffice as the results clearly show. Justify why you introduce additional complexity. Furthermore it is uncommon to specify the RMS for MRS in per cent, usual is nV since the ambient noise level does not depend on the data. You show the decay time of the aquifer. Can you make any implications to pore-related parameters or even hydraulic conductivity?

Fig. 6B hard to see anything, better show contour map of fresh/saltwater interface

Fig. 7 show also the measured sounding curves. Are the time differences significant in terms of resolution?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 5261, 2012.

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