Hydrol. Earth Syst. Sci. Discuss., 12, C4878–C4881, 2015
www.hydrol-earth-syst-sci-discuss.net/12/C4878/2015/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "A framework for testing the use of electric and electromagnetic data to reduce the prediction error of groundwater models" *by* N. K. Christensen et al.

Anonymous Referee #2

Received and published: 16 November 2015

This review is of Christensen et al., "A framework for testing the use of electric and electromagnetic data to reduce the prediction error of groundwater models." This manuscript highlights development of a joint hydrological and geophysical framework to estimate the value of including geophysical measurements along with hydrological ones to predict certain hydrologic output parameters. Overall this is a well written manuscript on an extensively tested experiment. There are some limitations related to the entirely synthetic nature of the experiment that bring about questions detailed below. Importantly, a better link with true hydrologic systems and discussion of relevance to past work is essential or it is difficult to see why this work should be published in a hydrology journal. I recommend this manuscript be returned to the authors for revision.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

Overall Comments:

Some of the largest challenges with coupled or joint inversion are linking geophysical measurements to hydrological parameters of interest. In this manuscript, the authors almost entirely neglect this with the justification of demonstrating an example (resistivity is assumed to have a direct relationship to K, porosity is assumed to be known). How is it possible to know that the absence of reliable hydrologic output parameter prediction isn't due to the poor petrophysical relationship? After all, if a fully synthetic system is designed and then converted between hydrologic and geophysical properties using an empirical or semi-empirical petrophysical model the petrophysical model may be incorrect. How can the authors justify enforcing a link between hydraulic conductivity and resistivity, but not porosity (as Kozeny-Carman would require)?

A discussion section is absent. The authors helpfully identified previous simultaneous inversion examples "Linde et al. (2006), Herckenrath et al. (2013a) and Vilhelmsen et al. (2014)," and it would be helpful to relate these current results to the past examples. Alternatively, if the results of this investigation cannot be related to past experiments due to the highly synthetic nature of the study, then I question it's relevance to a hydrology journal and suggest consideration of a engineering journal may be more appropriate to document the development of the HYTEB computational environment. I suggest including a table of all symbols and definitions. There are many symbols used in this manuscript, and some of them are ambiguous (for example, small sigma may be used to refer to electrical conductivity or standard deviation, although I think it is always standard deviation in this manuscript.)

Line Comments:

Replace all "worth" with "value."

P9604, L:9: "play back" idiom. Consider replacing.

P9604, L:9-10: The wording in this sentence is awkward. Suggest rephrasing.

HESSD

12, C4878–C4881, 2015

P9613, L. 26: “Fig. 2” The text on this figure is hard to read and in some cases overlapping. I suggest redrawing for clarity.

P9616, L23: I understand that assuming a relationship between res and K is handy for simplicity, but it is also highly unrealistic. What will be the impact when a realistic relationship must be used when incorporating field data? How should that relationship be developed in order to work properly within this modeling framework?

P9619, L16-17: This is a bit confusing –porosity is a key and critical parameter. How is it justified to assume it is known? Also, it seems like the Archies type relationship for porosity might be more reliable than estimating K from resistivity, so why is K the one calculated and porosity?

P9619, L21-24: Since the numbers of layers in the geophysical model is linked to the number of layers in the synthetic geological model, does this mean it is required to know the number of geologic units in a real scenario a priori?

P9624, L10: How computationally intensive was it really? What kind of limitation might this pose for general users to HYTEB?

P9621, L18: It appears here that hydraulic conductivity is now represented as lowercase-k, rather than uppercase-K as in table 1. Is this significant? An error? What is the difference between these k’s? P9627, L21: “Figure 6” the figures have a lot of overlapping points and numbers – hard to decipher overall. Suggest re-drawing for clarity.

P9627, L25: “Mean Error” Can the ME value reported on each panel of Figure 6 be interpreted as “Smaller is better”? In other words, would it be possible to interpret these results as “for each parameter, the model prediction with the smallest ME is the most well resolved”? If so, perhaps placing an identifying mark on each panel of this figure matrix would help the reader see more easily which is performing best and second best for each parameter? I think it would enhance clarity.

HESSD

12, C4878–C4881, 2015

P9628, L11-12: “the scatter around the identity line is larger for HI calibrated models than for JHI calibrated models” it is really hard to tell!

P9632, L1: The purpose of the long summary text is unclear and conclusions are nearly absent. I suggest removing the summary text and instead focus on developing a clear, concise conclusions section.

Table 1: The caption for the figure needs to be improved and the definition of each parameter needs to be included. I see the table referenced on p. 9614 line 6 for the first time, and no clear definitions of the symbols in the table are included there either in the immediate vicinity. K is clearly hydraulic conductivity, I presume “R” is resistivity given equation 1 on 9691, line 25, however in eq. 1, the Greek symbol rho is used. Typically R is “Resistance,” not a physical property. I presume the last symbol is phi for porosity, but how is this calculated, or how does this value link with the K-to-resistivity transform? Clearly all three must be linked somehow (P9619, L16 would suggest that this is not the case – this should be expanded upon, justified, and rectified).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 9599, 2015.