

Interactive comment on “Self-potential investigations of a gravel bar in a restored river corridor” by N. Linde et al.

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This paper presents a thorough analysis of self-potential (SP) sources in a gravel bar along a restored river corridor. The conclusions are generally well supported by the results and I believe that this study will be of interest to any scientist interested in utilizing the SP method for hydrogeological applications. This is a very clean, concise, and well written paper. Figures are generally of high quality, easily understood, and relevant to the text. I have a few suggestions for minor revisions that may improve clarity:

General comments:

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1. It's difficult to get a feel for the degree of topography on the site (except that it wasn't included in the SP inversion, so I assume that the area is relatively flat). Hydraulic head is given as an elevation (as is reasonable), but everything else is given in depth, making it difficult to relate hydraulic head to the other data and to get a feel for the consistency in the thickness of the vadose zone.
2. Hydraulic conductivity and permeability are referred to interchangeably. I find that non-hydrogeologists aren't always comfortable with the meaningful differences between the two or aren't really aware that they are different. They should be formally related or, better yet, stick with either permeability or hydraulic conductivity and make the necessary changes to the equations.
3. Under section 3.3, you analyze the coherency between particular SP results and rainfall, water content, and hydraulic head. It is unclear why you have chosen the particular SP sites that you have, and they do show quite different results in some cases. Is there anything about the gravel bar that makes you think a particular area is more sensitive to head or vadose-zone processes? Is the soil thicker or thinner? Could you possibly tie the variability in source-generating processes to some variation in site conditions?
4. In section 3.3 (wavelet analysis) you appear to conclude that the water content is more strongly correlated to the self-potential data than rainfall intensity. Rainfall intensity and water content appear to be strongly correlated processes (as one would expect), and I'm not convinced that the two are distinguishable by the wavelet analysis. In Fig. 5, it appears that SP3 is more strongly correlated to rainfall and water content than SP5. The use of SP5 in the analysis of rainfall may be biasing the result towards water content. It may be useful to see the coherency of one SP site (such as SP3) to each of the comparison data sets. In Fig. 6, clearly some of the SP sites show more similarity to hydraulic head than the other data, but again I'm not that convinced that rainfall and water content are notably different.

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5. In section 3.4 (modeling), did you only try the hydraulic conductivity values listed in the table? I would be interested to know how sensitive your SP modeling results are to changing contrasts in permeability and coupling coefficients. Also, is your hydraulic conductivity value selection related to the average gravel hydraulic conductivity value listed in section 2.1?

6. Also in section 3.4, I'm unable to tell from Fig. 4 if a 10cm change in head within 1 hour is reasonable with respect to your field data. A sentence or two explaining your reasoning for choosing these model criteria would be helpful.

Line specific comments:

Line 76: The paragraph starting on this line seems a little out of place. In the previous paragraph, you do a very nice job of highlighting the potential of SP for hydrogeologic investigations, and the paragraph beginning on line 81 naturally follows this train of thought. The paragraph on line 76 interrupts this thought and, with the exception of establishing that SP has been used near rivers in the past, doesn't gain much relevance to your study and seems unrelated to the discussion of non-uniqueness. I suggest moving this somewhere else where it won't interfere with a very worthwhile discussion.

Line 93: In the sentence beginning with "Nonetheless, it is quite clear..." The meaning of your statement isn't clear. Do these referenced studies find that no general linear relationships exist (and you are in agreement) or did these studies suggest that there are clear relationships (and you are in disagreement). Different phrasing would be helpful here.

Line 127: How was this hydraulic conductivity value obtained? Suggest referencing.

Line 141: Do you have available data to relate the changes in discharge to changes in river stage? It would be useful to get a feel for the total head fluctuations one might expect to see in the area.

Line 378: Do you have a physical reason why SP11 would show so much drift com-

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pared to the other electrodes? It seems that construction and installation are fairly uniform in your study.

Line 392: Does the daily variation seen in SP2 imply that this electrode was more susceptible to temperature variations than the others? If so, was it not buried as deeply?

Line 423: In this paragraph and in Fig. 7, I suggest labeling your model units as "unit 1" etc... The discussion of the boundary conditions takes a little bit of work to follow when you refer to "clay."

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