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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Technical Note: Deciphering the Hydrologic Response of Riverbeds across Changes in Recharge with Electrical Resistivity Imaging" *by* Weston J. Koehn et al.

Anonymous Referee #2

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The presented manuscript describe the use of Electrical Resistivity Imaging (ERI) for imaging seasonal resistivity changes for three profiles at the Arkansas river. Aim is to get insight into recharge and discharge mechanisms, a very interesting question for which ERI is an appropriate method to be used along with others to gain understanding. After describing the hydrological setting, they spend a few sentences on the ERI method, the used instruments and cables. In the result section they show for each profile some pictures along with an image of the absolute resistivity changed inferred from the inversion of the measurements. The conclusion consists of four already-known

statements, four very general ERI interpretations and four outlooking sentences.

I am not familiar with the rare manuscript type "Technical Note" and how the evaluation differs from a normal paper. The instructions describe it as "Technical notes report new developments, significant advances, and novel aspects of experimental and theoretical methods and techniques"

I understand that for a Note a paper can (or must) be short but would expect some novel approach in either the measurement type, the data analysis or the understanding of processes. Neither of this seems to be the case. Additionally, more technical details are required, including the electrode spread, the used measuring protocol, and the inversion options (or approach) in order to understand the relevance of the results. The authors are apparently no experts in ERI. Apart from the vast literature in Applied Geophysics, there is a large number of ERI (particularly time-lapse) papers in hydrology journals (including HESS) that are widely ignored, some being very similar relevant. Specifically, there have been papers on monitoring river water - ground water interactions giving detailed background and conclusions. I see no lessons to be learned (significance), maybe only for the very specific site. But I see a lot of shortcomings in the description of the methodology that make it impossible to assess scientific quality. The organization is appropriate and the texts are well-written.

To summarize, I cannot recommend publication of the manuscript in the high-standard journal HESS, mainly due to lack of novelty and significance. In case a resubmission is recommended, a (very major) revision should include i) necessary details, ii) absolute resistivity tomograms as well as relative differences, iii) a thorough literature review and iv) a critical discussion of the results that go beyond the findings specific for your study area. In this case I would offer my services as reviewer.

Other comments

A Profile layout is missing, you just said that one profile is parallel and one is perpendicular. At least for the parallel it is questionable whether 2D conditions (constant

conductivity perpendicular to the inversion plane, i.e. topography) are met and if not how this could affect your results.

Details on the data analysis and results (data fit etc.) missing.

How did the river water conductivity change over time? This also includes temperature changes. Why did you not account for it in the interpretation or conclusions?

How was the river body treated in the inversion routine?

Particularly for the Lakin Site, the geometry did change as both the water level and the width of the river changed. How did you compare

Figures 4+5: You show absolute resistivity changes, which is is not really meaningful and therefore not used in literature. Please use relative change (in percent or as a ratio) that can be transferred directly into relative saturation (Brunet et al.).

Figure 1: denotation of subfigures is wrong: (B) streambed and saturated zone may be partially connected ==> (C) (C) streambed and saturated zone and are disconnected by a vadose zone => (D) Text uses Figure 1a etc., please be consistent.

Figure 5: very slight decreases are interpreted as huge recharge zones. However, I doubt that the typical resolution measures allow for such an interpretation. At least a critical discussion is missing.

Except the very recent paper of Watlet, papers on ERI in hydrology are extremely rare and rather old (>10 years). In the recent years there have been a number of papers, particularly in the HESS journal:

- Quantifying shallow subsurface water and heat dynamics using coupled hydrological-thermal-geophysical inversion, Anh Phuong Tran, Baptiste Dafflon, Susan S. Hubbard, Michael B. Kowalsky, Philip Long, Tetsu K. Tokunaga, and Kenneth H. Williams, Hydrol. Earth Syst. Sci., 20, 3477-3491, https://doi.org/10.5194/hess-20-3477-2016, 2016 - Monitoring hillslope moisture dynamics with surface ERT for enhancing spatial signif-

icance of hydrometric point measurements, R. Hübner, K. Heller, T. Günther, and A. Kleber, Hydrol. Earth Syst. Sci., 19, 225-240, https://doi.org/10.5194/hess-19-225-2015, 2015 - Three-dimensional monitoring of soil water content in a maize field using Electrical Resistivity Tomography L. Beff, T. Günther, B. Vandoorne, V. Couvreur, and M. Javaux, Hydrol. Earth Syst. Sci., 17, 595-609, https://doi.org/10.5194/hess-17-595-2013, 2013 - A geophysical analysis of hydro-geomorphic controls within a headwater wetland in a granitic landscape, through ERI and IP, E. S. Riddell, S. A. Lorentz, and D. C. Kotze, Hydrol. Earth Syst. Sci., 14, 1697-1713, https://doi.org/10.5194/hess-14-1697-2010, 2010

Other hydrology journals - Robinson, D. A., A. Binley, N. Crook, F. D. Day-Lewis, T. P. A. Ferre ′, V. J. S. Grauch, R. Knight, M. Knoll, V. Lakshmi, R. Miller, J. - Nyquist, L. Pellerin, K. Singha, and L. Slater, 2008, Advancing process-based watershed hydrological research using near-surface geophysics: A vision for, and review of, electrical and magnetic geophysical methods: Hydrological Processes, 22, 3604–3635, doi: 10.1002/hyp.6963. - Ward, A. S., M. N. Gooseff, and K. Singha, 2010, Imaging hyporheic zone solute transport using electrical resistivity: Hydrological Processes, 24, 948–953, doi: 10.1002/hyp.7672.

Outside of Hydrology: - Coscia, I., Greenhalgh, S., Linde, N., Doetsch, J. A., Marescot, L., Günther, T., Vogt, T. & Green, A. (2011): 3D crosshole ERT for aquifer characterization and monitoring of infiltrating river water. Geophysics 76(2), G49-G59, doi:10.1190/1.3553003.

There are also a couple of papers in HESS on groundwater/river water interaction without ERI being involved.

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