Anonymous Referee #1

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General comments:

The study presented in this manuscript describes time-lapse electrical resistivity imaging results associated with groundwater and surface water interactions in riverbeds, via data from three monitoring sites along the Arkansas River in Western Kansas. The research goals are well defined, i.e. investigating the different types of hydrologic connection between the groundwater and surface water via interpreting electrical resistivity changes as compared to vadose zone modeling. However significant methodological issues are not addressed and/or presented in details, which lead to critical concerns about the time-lapse electrical resistivity imaging results. I could sum up these different concerns in the following list:

Author Response: Thank you for the thorough review and mindful comments. Major revisions will include the following:

Expanded methodology to include: ERI survey setup, inversion criteria, model quality, and details about the time-lapse profiles

Added discussion to better explain how the ERI surveys can be used to develop new understanding of complex river-aquifer interactions both locally and regionally.

RC1: No information on the types of electrodes used throughout the experiments is provided, especially given the unusual set up including river crossing.

Author Response: A submersible electrode cable was used for portions of surveys crossing the river. Dry electrode cables were used for land based survey segments.

RC2: No information is given about the measurement protocols, and more specifically about the use of reciprocal measurements for assessing the measuring errors.

Author Response: . Reciprocal measurements were conducted to ensure that quality data were used for the inversions. Additional methodological details will be added to the revised manuscript.

RC3: No information is given on how the measuring errors have been assessed.

Author Response: . Survey details will be added to the revised manuscript.

RC4: There is also no information available about the parameters used for the inversions of the resistivity data, and especially on how the river water was taken into account in the inversion procedure.

Author Response: . The river water resistivity was measured at the time of each underwater survey, and used as an inversion parameter for underwater surveys. Specific details about the inversion and handling of the river water resistivity will be added to the methodology section within the revised manuscript.

RC5: The topography is apparently not included in the inversion despite clearly visible slopes in the field pictures. Not including the topography could lead to artifacts in the resistivity image. . .

Author Response: . The topography was included within the inverted resistivity sections however, the topography was not included within the time-lapse profile due to software limitations. The topography will be included within the images in the revised manuscript.

RC6: There is also no explanations on the way temperature changes have been corrected despite the great impact they can induce on the resistivity of the subsurface, as it is well described for example in Brunet et al. (2010).

Author Response: . No corrections for temperature changes were made for regions below the ground surface. However, the pore fluid resistivity was measured at the time of each survey, and used as an inversion parameter for submerged survey segments.

RC7: Presenting the changes in resistivity (in Fig. 4, Fig 5. and Fig. 6) as absolute changes of resistivity without showing the background resistivity image is definitely not the best option as clearly explained in the review of Samouëlian et al. (2005). A variation of 10 Ohm.m within a 4000 Ohm.m area is not exactly similar to a variation of 10 Ohm.m within a 50 Ohm.m area. . . Moreover, given that no information is given about the error level of the measured voltages, which informs on the signal to noise ratio, this is hard to tell if such small variations of resistivity are actually interpretable. . . Therefore, the interpretations of the changes in resistivity presented in the manuscript cannot really be trusted with a reasonable level of confidence. I also doubt that the chosen format (i.e. Technical Note) is relevant for presenting these results as this manuscript does not present significant advances or novel experimental techniques. Imaging hydrological processes with time-lapse electrical resistivity imaging has already been addressed by several publications, including HESS papers, for the last 10 years. In summary, this paper has interesting goals and the electrical resistivity imaging techniques is an appropriate choice for addressing the associated scientific questions. However critical concerns are raised about the methodology applied for processing the data and visualizing the resistivity results. In my opinion, a significant amount of detailed information is still required for publishing this study. I would recommend a major revision of this manuscript, starting by better explaining the methodology used for producing the resistivity results. This will also most probably require from the authors an additional processing of the resistivity data to include at least the topography and corrections for temperature variations.

Author Response: We revised a full manuscript w/ details to a technical note at recommendation of editor. This removed lots of geophysical details (including background resistivity images). We will include as much detail as possible while staying within the technical note page limit. A major revision of the methodology section will be conducted to better explain the setup and processing of the geophysical results. The revised manuscript will present the changes in resistivity as ratios.

Details about the inversion quality and measurement errors will also be added. A detailed discussion regarding temperature variations will also be added.

Specific comments:

RC9: Introduction: The goals of the research are well presented, but some state of the art papers are missing. These include for example Binley et al. (2015), Chambers et al. (2014), Descloitres et al. (2008), Uhlemann et al. (2016), which could help the authors in exploring approaches for better presenting their results.

Author Response: The introduction will be rewritten to include the novel aspects within the suggested references.

RC10: Figure 2: There is a (A) in the caption but no (B), while there is no (A) nor (B) in the figure. Including a view at the continental scale in the top left corner of the left subfigure could be more convenient. The font size of the legend in the bottom left corner is too small.

Author Response: Figure 2 will be reformatted as suggested.

RC11: Figure 3: Linear interpolations between borehole logs are probably not the best ways to draw a geologic cross-section. Also, B and B' seem flipped compared to Figure 2 or the x axis has to be flipped in the right side of Figure 3.

Author Response: The borehole to borehole cross section were originally constructed using eight different geologic units. The use of geospatial interpolation) techniques (Inverse Distance Weighting and Kriging) to create soil horizions yielded unrealistic cross sections due to the high level of geologic heterogeneity. Therefore, all geologic units were grouped into the categories shown in Figure 3 to allow for the creation of generalized cross sections by manual linear interpolation.

RC12: Page 5: the interpreted changes in resistivity for the Hartland site or the Lakin site are generally very small: 10 to 20 Ohm.m (line 4), 1 Ohm.m to 10 Ohm.m (line 5), 5 Ohm.m (line 14). These can be attributed either to artifacts from the inversion, noise in the measured voltage or temperature variations instead of actual changes in soil moisture content. Presenting changes in resistivity as resistivity ratios as it is generally the case in other studies would be much more convenient to evaluate whether this changes mean anything related to hydrological processes.

Author Response: The time-lapse profiles will be reprocessed and presented as resistivity ratios to improve interpretability. A detailed discussion will be added to explain the merit of the geophysical interpretations as they relate to hydrologic processes.

RC13: Figure 5: the changes in resistivity interpreted as recharge zones are so small that they could be associated to anything else than actual recharge. . . No topography is included in the resistivity model while slopes are clearly visible at the riverbanks in pictures in

(A) and (B).
(B)

Author Response: The time-lapse images will be reprocessed to show the topography that was used to invert the background resistivity profiles.

RC14: Page 5 line 8: “The ERI does not reveal soil heterogeneity in the profile”. I would like to trust you but it would be easier if the resistivity of each site was shown in the figures.

Author Response: The background resistivity images will not be shown within the revised manuscript due to page limits however, the topography and inversion quality will be included to improve quality and interpretability.

RC15: Page 6 & 7: The changes in resistivity measured at the Holcomb site are larger than for the other sites, which make them more reliable, even if the lack of information concerning how the temperature change was taken into account is still problematic for initiating further interpretations. Discussing why these changes in resistivity are larger than for other sites could also be helpful to understand the different hydrological processes that the paper aims to describe.

Author Response: Additional discussion about the temporal changes in resistivity will be added to better emphasize their role in understanding hydrologic processes.

Technical corrections

RC16: Page 5 line 7: attributed to

Author Response: The correction will be made within the revised manuscript.

RC17: Caption of Figure 4: “Note that the river is to the right”. To the right of the pictures or the resistivity model?

Author Response: The corrections will be made within the revised manuscript.

RC18: Page 7 line 6: the depth to the water table

Author Response: The correction will be made within the manuscript.

Suggested References:

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Brunet, P., Clément, R. and Bouvier, C.: Monitoring soil water content and deficit using Electrical Resistivity Tomography (ERT) – A case study in the Cevennes area, France, Journal of Hydrology, 380(1–2), 146–153, doi:10.1016/j.jhydrol.2009.10.032, 2010.

Samouëlian, A., Cousin, I., Tabbagh, A., Bruand, A. and Richard, G.: Electrical resistivity survey in soil science: a review, Soil and Tillage Research, 83(2), 173–193, doi:10.1016/j.still.2004.10.004, 2005.

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