Response

Article title: Combining time-lapse electrical resistivity and self-potential methods to assess soil moisture dynamics in a forested catchment under the rainfall event

Reference No: hess-2023-190

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The detailed responses can be found below.

Concerns:

1. The paper represents a relevant example of ERT and SP for the characterisation of forested catchment. The paper meets the scope of HESS and deserves publication after few minor revisione listed here below.

Response: Thank you very much for your very kind and professional comments.

2. Ln 84 resolution of decimetres may seem too ambitious, since your spacing was 0.5 m. Maybe you can chance in a generic 'high resolution'.

Response: Thank you for reminding us of the improper description in the manuscript. We changed the expression “resolution of decimeters” to “high resolution” at line 84.

3. Ln 95-100 maybe ';' instead of '.' in the list

Response: Thank you very much. We have changed the “.” to “;” at lines 95-100.

4. Fig 1 provide latitude and longitude of the area for a better geographical constrain.

Response: Thanks for your valuable comment. We provided latitude and longitude of the study area in the Figure 1.

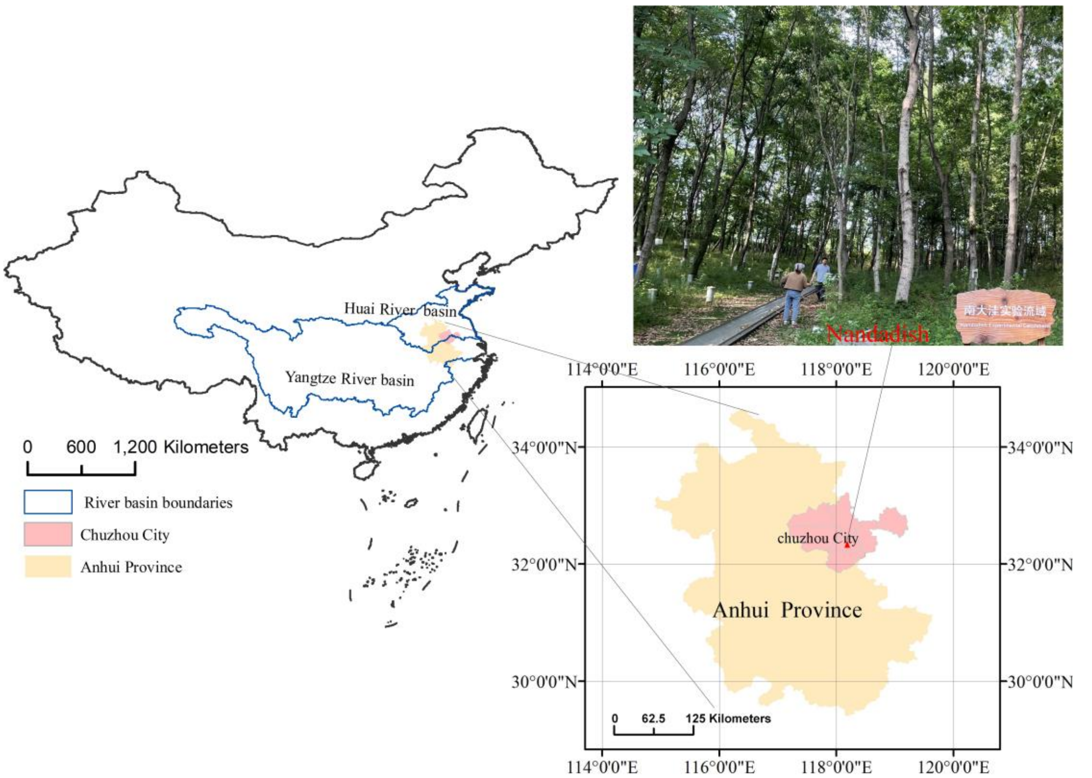


Figure 1: Location of the Nandadish site in the climate transition zone from subtropical to warm temperate, eastern China.

5. Ln 132 missing dot at the end of the sentence

Response: Thank you. We have added the dot at the end of the sentence at line 133 in the revised manuscript.

6. Fig 2 panel showing the vertical deployment of instruments is not clear, maybe insert axis as depth cm

Response: Thanks for your helpful suggestion. We have inserted the axis as depth to clearly show the vertical probes and self-potential (SP) electrodes in the Figure 2.

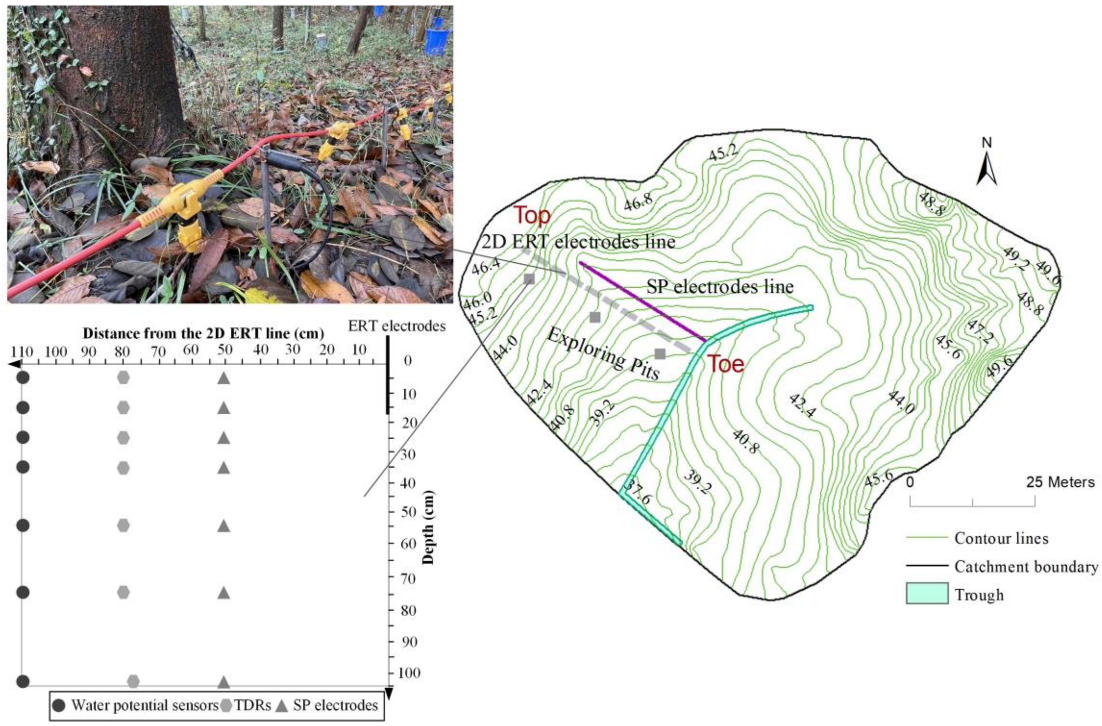


Figure 2: Experimental setup of the slope at the Nandadish site, including the location of ERT electrodes, SP electrodes, TDRs and water potential sensors.

7. Ln 161 How was put the water if the system works unattended and managed from remote ? Not clear this part

Response: Thank you very much. We conducted an electrical resistivity tomography (ERT) survey every two weeks (remotely monitored by GD-20). If the contact resistance increased significantly due to the drought, we would go to the Nandadish experimental site and pour a little salt water into the ERT electrode position to avoid possible anomalies in the contact resistance. We changed the sentence at lines 163-165 in the revised manuscript to "Meanwhile, to avoid anomalies in the contact resistance during drought and further improve the data signal-to-noise ratio, a little salt water was added to slightly wet the soil around the electrodes (Pavoni et al., 2022)."

8. Ln 164 why it was not possible to collect reciprocals in dipole dipole array configuration? You should have more robust error estimation

Response: Thanks for your suggestion, which is highly appreciated. It was possible to collect reciprocals in dipole dipole array configuration. However, reciprocals need more time, which may decrease ERT time resolution. Considering that our research requires rapid collection of fast water flow processes during rainfall, we did not collect reciprocals. This is also the reason why we not used the reciprocals for a more robust error estimation. To express more clearly, we revised the expression as "While we did not collect reciprocals (current electrodes and potential electrodes are swapped) due to the experimental design for the determination of the fast flow process" at lines 168-169 in the revised manuscript. "Referring to Carey et al. (2019), we used the stacking error to assess data quality." We also added this statement at line 203 in the revised manuscript.

9. Ln 168 for contact resistance problem affecting inversion consider DOI 10.1002/nsg.12192

Response: Thank you very much. We have cited the research paper at line 173 in the revised manuscript. In addition, we also cited this article at line 165 in the revised manuscript to describe our handling of the poor contact resistance.

10. Ln 190 how the 3% error was chosen? what about stacking error in the dataset?

Response: We are very grateful for your valuable comments. "In equation (2), $\mathbf{W}_d$ is an error weighting matrix, $\mathbf{W}_d = \mathrm{diag}(1/\varepsilon_1, \ldots, 1/\varepsilon_N)$, where N is the number of measurements and ε_i is the data error. ε_i is also the standard deviation of d_i, $\varepsilon_i = \sigma(\ln R_i)$, R_i is the measured resistance. It can be obtained by the comparison of normal and reciprocal measurements (Garré et al., 2011; Robinson et al., 2012; Beff et al., 2013; Cassiani et al., 2015, 2016). Due to the time constraints, we did not obtain the reciprocals. Referring to Carey et al. (2019), we used the stacking error to assess data quality. Also, to minimize the measuring time, our stacking was set to 1. The standard deviations of stacking from ERT measurements with an average of 3% were used for the inversion in the whole time series." We also added these content at lines 199-205 in the revised manuscript.

11. Fig. 5 why time lapse is presented with different reference background ? Maybe caption must be improved

Response: Thank you very much. Usually, time-lapse resistivity results are presented using the first moment as the reference background to calculate the percentage change of resistivity over time. In this paper, due to the continuous rainfall, the percentage change of resistivity between the tomogram 3 with tomogram 1 as a reference and the tomogram 2 with tomogram 1 as a reference were very close, and it is difficult to identify how the resistivity changeed from tomogram 2 to tomogram 3. Therefore, we would like to analyze the percentage change of resistivity at adjacent moments (the percentage change of resistivity in the tomogram 3 with tomogram 2 as a reference), so that the resistivity change process can be more finely described during the rainfall process. To express more clearly, Figure 5 has been reformatted and its title was has been revised as below. These are also presented in the revised manuscript.

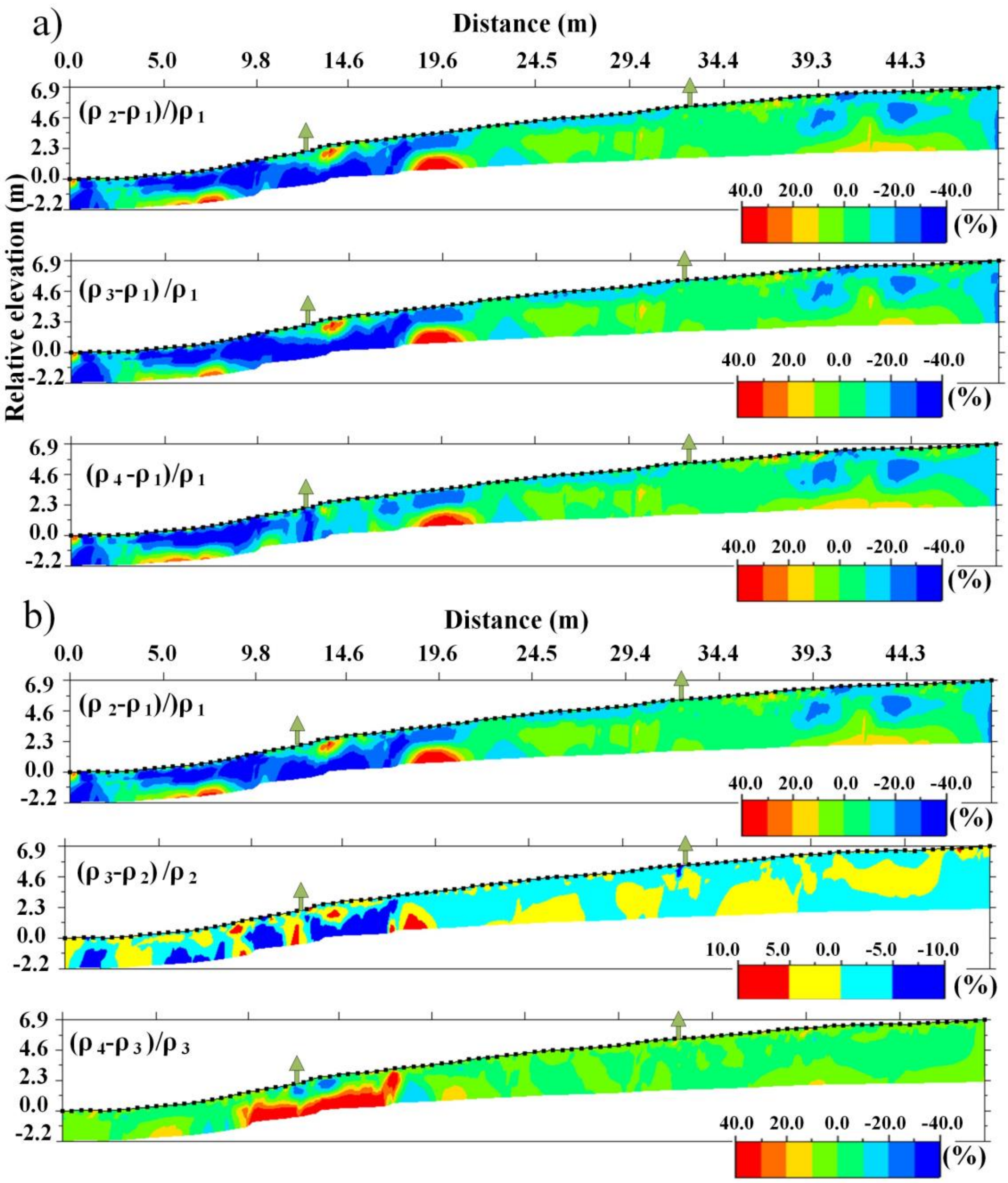


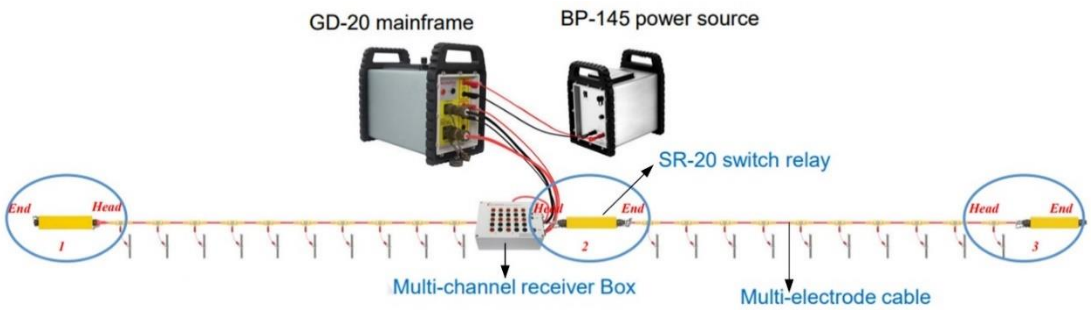
Figure 5: Percentage change in resistivity: a) The percentage changes of resistivity with tomogram 1 as a reference background and b) the percentage changes of resistivity with previous moment as a reference background.

12. Fig. 7 explain in caption what is the grey dashed line

Response: Thanks for your suggestion. "Two gray dashed lines represent the contour lines of the seismic wave velocity, the upper line shows a velocity of 0.5 km/s and the lower line shows a velocity of 1.2 km/s." We also added these explain in the caption of Figure 7.

13. Ln 436. How many channel can manage the adopted GD-20 Instrument? In the market there are several georesistivimeter able to measure all the potentials electrodes combination in one time (eg for dipole-dipole). This would considerably reduce the amount of time for acquisition.

Response: Thank you very much. The GD-20 instrument adopted a segmented design, utilizing the unique SR-20 bidirectional swich relay to achieve electrode switching in high-density ERT measurement and allowing for unlimited connection in the cross-section. As shown in the figure below, the power source can be replaced with in-line modules that used the software named Geomative Studio to connect with the PC for remote measurements. In our experimental setup, we used eleven SR-20s with ten channels of multi-electrode cable between the SR-20s to connect the ERT electrodes.



14. Ln 476 for 'piston effect' in ERT findings and old water consider Cassiani et al 2016 (DOI10.1016/j.scitotenv.2015.03.113)

Response: Thank you very much. We considered the literatures at line 495 in the revised manuscript.