

Interactive comment on “Quantifying Shallow Subsurface Water and Heat Dynamics using Coupled Hydrological-Thermal-Geophysical Inversion” by A. P. Tran et al.

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General Comments The paper concerns an interesting and innovative procedure of coupled inversion for hydrological and geophysical parameters. In particular Authors present double phases air-water-heat inversion coupled with ERT data. Tran et al. show the results for both synthetic test and real data, with a relevant sensitivity analysis of the parameter estimation which highlights state variables resolution capabilities. The topic is of interest for HESS readers and the manuscript is concise and well written. Despite this, I suggest minor revision before the acceptance for publication: some points need to be better clarified, some figures should be revised cause they are not at the level of the paper, some captions need improvement. Here below a list of detailed

C1

comments.

Specific Comments The Manuscript comes without a continuing lines numbering, restarting in every pages. This usually does not help the revision work. I will refer to page number and relative line numbering. Pg3 Ln 20-25 Sentences not clear to me. You cannot assert that difficulties in hydrogeophysics are linked to temporal/spatial resolution variables problems, and then refer to the high resolution of autonomous acquisitions (?). As in the paper of Binley et al. you cited, several methods are applied second their proper potentials. On the other hand I agree with you we are still far in properties characterization, and your paper represents a relevant step forward. Pg4 Ln 8. I suggest suspension points after properties affecting resistivity description, cause it is not (and cannot be) exhaustive. Ln 24. I'm always prudent when reading there are no similar attempts in the previous literature. Some different works partially fronted the topic (e.g. Jardani et al 2013; Irving et . 2010), but this does not affect the quality of yours work. Probably the differences stay in the design of coupled hydro-geophysical inversion, and the level of results obtained. Pg6 There is probably an error in the symbol of porosity in Eq2 or in the text. Pg9 Ln3. There's no need to introduce the relation between resistivity and conductivity here.Ln 10-15. (fig1). The flowchart is unclear and the caption confusing. I understand it is ambitious describe graphically all the inversion scheme, but I suggest to redrawn the flowchart and explain better this crucial part of your relevant work. Pg10.Ln20. I do not understand the sentence about initial guesses, it sounds unnecessary. Explain simply your (elegant) procedure. Pg12Ln5 (fig2). Map figure should be re-drawn, it is not well readable, missing coordinates, label and fonts are too small Pg13.Ln1 What is the relationship with yours work and Arora et al. one? Not clear why do you present extensively this biogeochemical topic here. Ln 18. Why the hydrological model contains simply two geological layers? This is not specified. Fig.3 should be revised. Please put unit over the scale and not with X label. It is unusual the starting with negative distance values. Ln 19 Please insert citation introducing Wasatch layers resistivity, otherwise these seems reasonable but not supported considerations (and should be placed in the discussion section). Ln 23.

C2

Please introduce before the characteristics (e.g. a stratigraphy description) of TT02 and TT03 boreholes. Pg14 Ln 11. How do you approximate bottom temperature from land surface temperature? Pg15 Ln13. Some confusion between m (meter) and matric potential symbols. Fig.4 Caption should be improved to explain better these relevant sensitivity graphs. Tab.1 Table is quite confusing to me and caption does not help. Explain better what's from hydrological inversion and what's from the coupled one. Note: 'To' miss the initial bracket?

Thanks for the reading of a very interesting and well written work, which in my opinion opens important further perspectives for hydrological characterization.

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