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Interactive comment on "Coupled Land Surface-Subsurface Hydrogeophysical Inverse Modeling to Estimate Soil Organic Content and explore associated Hydrological and Thermal Dynamics in an Arctic Tundra" *by* Anh Phuong Tran et al.

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We would like to thank the reviewer for their evaluation and constructive comments, which definitely helped to improve our paper.

I enjoyed reading your paper and the authors of the paper describe an interesting combination of coupled hydrogeophysical inversion using also thermal properties. The investigation of uncertainties and to analyze the influence of different data sets to im-

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prove the results is a very interesting topic and highly important for coupled inversions. Coupled hydrogeophysical inversions have been widely used in the last years, but the extension to thermal parameters is still rare. Generally, I think the paper is well written and all the important steps are nicely explained. I have some minor comments that could help to make same things clearer and improve the manuscript. After addressing them I recommend publication.

1. Introduction: Please discuss in more detail coupled hydrogeophysical inversion in terms of other geophysical methods. What are the benefits of ERT compare to GPR or seismic and why did you prefer this for you study. Mention the resolution of different methods and what are the limitations of what can be obtained.

Reply: We added text describing why we chose to develop the hydrogeophysical inversion approach using ERT in the revised version as below (lines 8-14, page 4):

Of the geophysical techniques commonly used for monitoring the shallow subsurface, ERT is increasingly common because it can autonomously provide 2- or 3-D time-lapse measurements with a relatively high spatial resolution, is sensitive to properties influencing hydrological-thermal dynamics, and is particularly suitable for field deployment over a long period of time. As a result, we use ERT data in this study.

2. Regarding the ERT data: a. Page 13: It would be nice to show also one ERT transect from the measured data and indicate the defined boundaries and structures in there. b. Please give more information of the ERT and the inversion. How reliable are the ERT results at a depth of 0.1m when using a spacing of 0.5m? c. Page 14, last paragraph: Considering measurement errors are highly important, but did you also consider uncertainties of the actually layer thicknesses obtained by the ERT?

Reply: a) Figure 4 was modified to add an inversion of ERT data collected at the Barrow, AK site on August 2013. The permafrost and active layers shown in the electrical resistivity map are discussed in the caption based on their resistivity values.

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b) As shown in Figure 4, ERT results at depth of 0.1 m are not clearly distinguished. That is the reason why joint inversion of ERT with soil liquid and soil temperature helps to improve the parameter estimation.

c) In coupled hydrogeophysical inversion, subsurface state variables (soil liquid/ice content and temperature) within the hydrological computation domain are transformed into resistivity values within the BERT computational domain. After that, the forward BERT model is used to simulate ERT data (resistance and inferred apparent resistivity). The simulated apparent resistivity data are then compared with the observed ERT data (apparent resistivity) (see procedure in Figure 1). We do not perform BERT inversion so we avoid the errors associated with geophysical inversion.

d. Page 15: Why do you use just 7 data set of the ERT, when you have data available for every day?

Reply: We only selected the 7 ERT datasets that represent the most important events. Adding more ERT data takes a longer time for the inversion but does not provide much more information about system dynamics. Because additional ERT does not significantly improve the parameter estimation, we did not include them. Still, acquiring ERT data with higher temporal resolution than used in this study is suggested to understand and select the datasets related to strong changes in soil resistivity (no necessarily known in advance).

Technical corrections: The manuscript is very detailed, which is generally very good, but please try to remove unnecessary sentences to shorten the text and to better concentrate on the results. Avoid sentences like “Figure XX shows. . ..”. I listed here some examples that could shorten the text. Please check this for all the location where figures and tables are introduced. For example: e. Page 17: last paragraph. The three sentences can easily be combined to one. f. Page 18 starting line 4: First sentence not necessary and combine with second sentence. g. Page 19, second paragraph: Rewrite to “The comparison between synthetic and predicted apparent resistivity data

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(Figure 14) shows that there is a very good agreement between them with no bias. . ...

Congratulations on a very nice job!

Reply: Some unnecessary sentences were removed/combine as suggested by the reviewer.

Please also note the supplement to this comment:
http://www.the-cryosphere-discuss.net/tc-2017-1/tc-2017-1-AC2-supplement.pdf

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