

Interactive comment on “Detailed detection of fast changes in the active layer using quasi-continuous electrical resistivity tomography (Deception Island, Antarctica)” by Mohammad Farzamian et al.

Anonymous Referee #2

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The manuscript “Detailed detection of fast changes in the active layer using quasicon-
tinuous electrical resistivity tomography (Deception Island, Antarctica)” by Farzamian et
al. presents automatic ERT measurements covering an entire yearly cycle at very high
time resolution at a remote location in Antarctica. Such measurements are extremely
rare, and the results are of high interest for the audience of TC. The manuscript, how-
ever, could be significantly improved by better focusing on the obvious question “can
such a system provide added value compared to traditional techniques”. I recommend
reviewing the content in this light, which should make it possible to identify superfluous

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parts and shorten the manuscript to some extent.

Major comments:

1. The authors show that the ERT setup facilitates estimating/measuring ground tem-
peratures, and the results are indeed impressive. However, ground temperature is
exactly the physical variable characterizing the thermal state of permafrost that we can
measure very well already. Playing devil’s advocate, one could bring forward that a
bunch of reliable and inexpensive temperature loggers could easily cover the spatial
and temporal scales that the ERT was set up for (at better accuracy and probably
lower cost). This is especially true since point-by-point calibration seems necessary
(Fig. 10) to convert resistivity to temperature. Ice and water contents, on the other
hand, are really hard to measure. The authors mention the transient layer as an ex-
ample for changing ice contents the Introduction (P. 3, l. 14, see comment below), but
no results are presented. If anything (semi-)quantitative regarding water and ice con-
tents can be extracted from the measurements, that would make the manuscript much
stronger. I do not question the selected setup or the results presented, but the authors
should provide the reader with a better sense of direction where they are going with
their research, and how far they have come with the presented results in this process.
2. The fast temperature changes (“events”) are interesting (and once again, it is im-
pressive that the ERT can pick them up). But most of the manuscript describes the
general evolution over a year which is even more important than fast changes for the
above-mentioned question “does such a system provide added value compared to tra-
ditional techniques”. I therefore recommend changing the title, not mentioning “fast
changes”, to better describe the (adequate) content of the manuscript.
3. In the Discussion, I am missing a reflection on the points that the ERT system
could indeed beat traditional (temperature) measurement techniques. In addition to
water and ice contents (see above), this could in particular be temperature monitoring
in deeper layers, for which expensive boreholes are needed. Furthermore, spatially re-

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solved (in lateral direction) measurements could be achieved by ERT, and some pattern is indeed visible in Figs. 7 and 9, but this is not discussed in much detail, except for the short paragraph on page 12. This could be discussed in more detail in the Discussion. Another application could be monitoring of changing salinities. The authors should discuss under which circumstances these different variables could be estimated/evaluated in permafrost settings.

Minor Comments:

P2

-l. 2-8: Please break this sentence up in several.

-l. 13: "indicates that our system set-up can successfully map spatiotemporal thaw depth variability" How quantitative does it become with respect to AL? Is "map" which means that spatial differences can be resolved the correct word to use here?

-l. 20: please describe the advantages/added value compared to having a borehole?

P3

-l. 14ff: does the presented method shed any new light on this issue?

P4

-l. 21: Isn't the site rather untypical for "conditions found in Antarctica", when considering all of Antarctica?

P5

-l. 22: please make clear that the "nodes" refer to active layer measurements, this could be confused with the actual ERT setup.

P. 7

-l. 9: delete "e.g."

C3

P16

L. 17: Is this realistic, considering the spatial resolution which would be required for a process like cryoturbation (for example at a mudboil)? What is the spatial resolution in the horizontal direction, that can be resolved by the system? Is it conceivable to use such a system with even finer spacing (e.g. 10cm) and still obtain good results?

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-39>, 2019.

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