

## ***Interactive comment on “Optimisation of quasi-3D electrical resistivity imaging – application and inversion for investigating heterogeneous mountain permafrost” by D. Schwindt and C. Kneisel***

**H. Juliussen (Referee)**

havard.juliussen@geog.uib.no

Received and published: 26 January 2012

In this paper the authors use synthetic modeling and field data to discuss optimisation of field acquisition of quasi-3D resistivity data, and inversion of the same type of data. The paper extends much of the work made on 2D ERT in permafrost research into the 3rd dimension. This new spatial dimension in resistivity imaging of ground ice is important for periglacial and geocryological process understanding. The main problem with 3D data, however, is the considerable time it takes to perform the measurements. Schwindt & Kneisel shows how the time spent in the field can be kept at a minimum

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by optimizing the data acquisition. They also discuss horizontal and vertical model resolution, to what degree synthetic model resistivity values can be reproduced, and inversion convergence. The paper communicates the results in a clear way and it is well written. I have only a few general comments followed by some specific comments that I would like the authors to consider. I recommend the paper to be published in The Cryosphere after a minor revision.

### GENERAL COMMENTS

1) The description of the grid layouts in p.3389 line 27 to p.3390 line 4 as well as in table 1 and figures 1 and 2 must be improved. The # of lines does not add up to the specified grid size. How do the grid size and # of lines in table 1 relate to the grids shown in fig 2? Uncertainty about what is X and Y direction adds to the confusion. In the manuscript you must specify when you use a complete XY-grid, half X-grid and no X-grid. This is not specified in sections 3.1, 3.2 and 3.3.

2) As already noted by the handling editor, you should consider the term “permafrost” and if it in some of your cases could be replaced by “ground ice” or a similar term.

### SPECIFIC COMMENTS

p.3385, line 2-4: many of the factors you mention in line 3 and 4 are microclimatic factors and should therefore not be listed specifically as you have already written microclimatic conditions in line 2.

p.3385, line 6: “periglacial and geocryological” instead of “permafrost related”?

p.3387, line 24-25: I do not understand this. To my knowledge you cannot verify assumptions drawn from synthetic modeling using field data. But you can do the opposite; use synthetic modeling to verify assumptions made from field data.

p.3390, line 27: “divided in half”, not “divided by half”.

p.3391, line 12: “high-resistive”, not “high resistive”. This should be updated for the

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entire manuscript.

p .3393, line 25-26: Reproduced matrix values are not reasonable beneath larger high-resistive structures

p .3393, line 28: you write that ALL arrays underestimated resistivity values, but in p.3394 line 3 you write that the double dipole OVERestimated the resistivity by 200%. Please check this contradiction.

p .3394, lines 9-15: This paragraph is a bit messy. First you write about underestimation, then about overestimation, and then about underestimation again. Can you reorganize the sentences without losing information content?

p.3396, line 9: although the increase is dramatic, it does not appear to be exponential

p.3397, line 9: "mountain permafrost" instead of "permafrost". (Large permafrost areas exist in the forested taiga areas).

p.3397, line 12: "input", not "income"

p.3398, line 10: "Due to the conductive humus. . ." is repetition and should be deleted.

p.3399, line 16: "divided", not "devided"

p.3406, line 26: "triple", not "t riple"

Figures:

The X and Y directions (and Z) should be indicated in all the figures, especially since you refer to X and Y positions in the text.

Fig 4. The positions of the Virtual Boreholes are not indicated in the XZ-slices. I also suspect there are some errors in the geocryological models as presented in the Virtual Boreholes: The virtual boreholes show a gradual transition from the high-resistive anomalies to the matrix resistivity that is not shown in the geocryologic model to the left in the figure. I believe this is a plotting error made in the Virtual boreholes. The

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axes labels and text in the Virtual Borehole panels is too small.

Fig. 6. The Block 3 Level 2 is not visible in the right panel (probably because it is below another line). Is it possible to change the appearance of the lines so that all lines become visible (different line thickness and colour?) or at least be mentioned in the figure caption?

Fig. 8. What is the Z value of the shown XY-slice?

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Interactive comment on The Cryosphere Discuss., 5, 3383, 2011.

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