AMT data distortion by the ECR and high-frequency IP effects in cold regions

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SUMMARY

In this paper we consider AMT and TDEM data acquired during the study of the permafrost rocks structure in Tazovsky district, Russian Far North. The straightforward 1D interpretation of raw AMT data suggests that the thickness of the seasonal thaw layer in this area is about 20-30 m, which is in complete contradiction with available a priori information. The actual thickness of this layer should be just about ~0.5 m, which is consistent with the independent 1D inversion results of the TDEM data collected along the same survey lines.

The first possible explanation of the revealed AMT data inconsistency is the electrode contact resistance or ECR effect, which affects the high-frequency CSAMT and AMT data collected with poorly grounded electric lines (Zonge and Hughes, 1985). This assumption is supported by the fact that the average ECR values in this survey was about 3-5 kΩ, which is considerably larger than the recommended maximum acceptable value of 1 kΩ for the AMT method (Zorin and Epishkin, 2022).

Another possible reason of the AMT data bias is the high-frequency IP effect typical for permafrost zones (Kozhevnikov and Antonov, 2006), which is supported by the fact that all TDEM curves in the survey area have sign reversals and thus could be interpreted only by 1D models with at least one strongly polarizable layer.

In our research we make and attempt to account for both ECR and IP effects in order to get a geoelectrical model consistent with the AMT data, TDEM data and geological a priori information.

Keywords: Audio-magnetotellurics, induced polarization, electrode contact resistance.