Shaky data and where to find them – MT on frozen lakes

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SUMMARY

Finland is commonly advertised as – a land of thousand lakes – in the media and public. However, in reality there are approximately 168 000 lakes covering up to 10% of the land area of the country. This large number of lakes can seriously obstruct planning and execution of any geophysical (in particular EM) fieldwork.

Within the BATCircle2.0 project (funded by Business Finland) GTK is currently collecting 3D MT data in north-eastern Finland north of the city of Kuusamo. In the centre of the study area lies the 240 km^2 lake Yli-Kitka which by applying traditional MT fieldwork procedures would cause a large gap in station coverage. As Finnish lakes reliably freeze over in winter, we used this opportunity to conduct a pilot study on the feasibility of measuring MT on the lake ice.

In beginning of February 2022, we installed 5 MT sites on the frozen lake Yli-Kitka with a site spacing of 2 km. For reference purposes we installed an additional site on land directly at the shoreline of the lake. While we obtained good data quality at the land site, we found very poor data quality between Periods of 100 s to 1 s at all lake sites. Closer inspection shows that this poor data quality is caused by a spurious signal on the magnetic channels. The measured signal is approximately 2 orders of magnitude larger than the natural MT signal simultaneously recorded at the land site, while the electric field channels seem to be unaffected by this effect.

This spurious signal is likely caused by movement of the lake ice due wind. This effectively prohibits standard single site processing of the measured time series to obtain MT transfer functions. Our findings are in accordance with McNeice and Jones (1998). One way to deal with such “shaky data” is to use magnetic fields from the land site to compute MT transfer functions. We are also discussing other options to remove or filter the spurious signal from the time series itself prior to any transfer function estimation.

Despite these challenges and difficult conditions in the field we found this pilot study to be successful. It shows that with some care it is possible to collect broadband MT data on frozen lakes. Allowing for easier survey planning with lake sites measured in winter and land sites during summer. In addition, being able to perform fieldwork during wintertime may also allow access of large frozen swamp areas which may not be accessible during summer months.

Keywords: MT, time series

McNeice, G. and A.G. Jones, 1998. Magnetotellurics in the frozen north: measurements on lake ice Contributed paper at: 14th EM Induction Workshop, Sinaia, Romania, August 16-23.