Wide range MT and GDS responses at Kakioka, Kanoya and Memambetsu

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An attempt to estimate the magnetotelluric (MT) response at periods ranging from 6 sec to 8 days is reported.

Geoelectric voltage differences have been continuously observed at Kakioka, Kanoya, and Memambetsu in Japan for more than 60 years by Kakioka Magnetic Observatory, Japan Meteorological Agency. Fujii et al. (2015) estimated the MT responses at the three sites by using the geoelectric and geomagnetic fields measured for a recent 11-year period (2000 to 2011); the responses were stably computed at the three sites at periods of 6 to 10^4 sec, and the period was extended to ~10^6 sec at Kakioka and Memambetsu. However, the responses at the longest period band have large error bars or show unreasonable behaviors.

In this study, I update the MT responses at all three sites at periods longer than 10^4 to complete a response data set at a very wide period range. Sq variations and a long-term trend caused by the instability of the observation system need to be removed before estimation of the response in this period band.

The least squares fit of the sinusoids over specific periods were used to remove the Sq and tidal influences from both the geoelectric and geomagnetic fields. Periods considered are 24 hours and their harmonics including seasonal variations of the Sq amplitude as well as major tides.

The robust Kalman filter procedure was applied to the geoelectric field to remove the long-term trend. A hyper parameter for the trend component was set for a flexible variation and estimated trends contains variations at periods longer than 2 days.

Then, I tried to estimate the MT response at periods from 10^4 to 10^6 sec at the three sites. Four tensor components of the response at periods shorter than about 10^5 sec are successfully obtained. The responses connect smoothly at the period of 10^4 sec to those at shorter periods. At periods longer than 10^5 sec, the MT responses related to the northward component of the geomagnetic field (Zxx and Zyx) are stably computed, while those related to the eastward component of the geomagnetic field (Zxy and Zyy) have large uncertainties. This is probably because of the source field geometry. The coherence between the geoelectric and geomagnetic fields starts decreasing at 10^4 and starts increasing at the period of 2 x10^5 sec.

The induction vectors and phase tensor parameters were also computed at the three sites. KAK and KNY have similar induction vectors and phase tensor. MMB shows three dimensional features.