Noise reduction in the seafloor EM data based on MC-NMF

Amano, R.[1], Goto, T.[1], Kasaya, T.[2], Yoshimura, R.[3], Hiramatsu, Y.[4],
Ishizu, K.[1], Yamamoto, S.[1]
[1]University of Hyogo, amano@earth-univ-hyogo.jpn.org
[2]JAMSTEC
[3]Kyoto University
[4]Kanazawa University

SUMMARY

Magnetotelluric (MT) method has been used to image deep subsurface resistivity structures. MT data often suffer from noises caused by the surrounding environment. The noises result in large errors in estimated MT response functions. Robust Remote Reference (Chave et al., 1987) is conventionally applied to such noisy data. However, frequent noises continued in the time domain are often correlated with geomagnetic fluctuations at the reference sites. The conventional method is less effective for these noises. We focused on Multi-Channel Nonnegative Matrix Factorization (MC-NMF), which can decompose spectrograms of observed data into some components as “Basis” so that each Basis is sparse (Sato et al.,2020). Noise can be reduced by removing Basis containing noises. In this study, we first determined optimal length of the short-time Fourier Transformation (STFT) which is preprocessing for MC-NMF. The STFT length was set to 128s, 256s, 512s, and 1,024s. MC-NMF was applied to synthetic data which spike noise was added to the time series from the Kakioka Magnetic Observatory. We used the MC-NMF code by Sato et al. (2020), the results applying each STFT length were compared. When the STFT length was only 1,024s, geomagnetic variations and noise were properly separated. Real field data was decomposed using MC-NMF: electromagnetic field variations acquired by an ocean-bottom electromagnetometer (OBEM) deployed off the Noto Peninsula, Japan Sea. The Basis in OBEM data were compared with the Kakioka Basis as reference sites to determine which Basis contained significant noises, and noise reduction was performed. As a result, most of the spike noise contained in the OBEM data were adequately reduced. We also discussed the characteristics of noise recorded in OBEM data.

Keywords: Noise reduction, Magnetotellurics(MT), Nonnegative Matrix Factorization(NMF),