CMT catalog based on a local 3D structure model for simulations of long-period ground motions in the Kanto region, Japan

*Kazuo Yoshimoto[1], Kosuke Minamihama[1], Shunsuke Takemura[2], Katsuhiko Shiomi[3]

1. Yokohama City University, 2. Earthquake Research Institute, The University of Tokyo, 3. NIED

Long-period ground motions associated with shallow local and/or regional earthquakes have been observed in the Kanto region due to the excitation and amplification of the Kanto sedimentary basin structure. To improve the evaluation of the characteristics of long-period ground motions, it is necessary to have an accurate information on focal mechanisms of earthquakes. However, moment tensor inversion using a 1D velocity structure model had been commonly used to construct a focal mechanism catalog in Japan. In this study, we conducted centroid moment tensor inversion using a 3D velocity structure model (the Japan Integrated Velocity Structure Model version 1 (JIVSM) [Koketsu et al. 2012]) to estimate the focal mechanism solutions of earthquakes in and around the Kanto region more accurately. Then, we compared our focal mechanism solutions with the MT solutions of F-net.

For the 3D CMT inversion, we analyzed 82 earthquakes of magnitude 5.5 or greater occurred between January 2004 and June 2020 (Lat.: 34°N~38°N, Lon.: 138°E~142°E, Depth: 40 km or shallower). The broadband seismic waveforms recorded by F-net were used for our 3D CMT inversion, and the displacement waveforms in the period band of 25~100 seconds were used for waveform fitting. The Green's functions of the seismic motion for the 3D velocity structure model were evaluated by the reciprocal calculations via the OpenSWPC [Maeda et al., 2017]. In this calculation, source grids were uniformly distributed at a horizontal interval of 0.1° and vertical interval of 2 km from depth 6 km to 60 km. The Küpper wavelet with a duration of 1 s was employed as a source time function. The reproducibility of the observed waveforms was evaluated by the variance reduction (VRs), and the moment tensor, centroid location, and time of occurrence of the earthquake were estimated by searching for the solution with the maximum VRs. Other details are described in Takemura et al. (2021).

We compared our 3D CMT solution with the F-net MT solution, and found that the two solutions are highly consistent over the land area. The Kagan angle, which was calculated as an index value for comparison, is generally less than 30° for all earthquakes. However, the difference between the 3D CMT solution and the F-net MT solution is larger for earthquakes that occurred in the offshore region such as off the coast of Ibaraki Prefecture and near the triple junction off the Boso Peninsula. This result suggests that the use of an appropriate seismic velocity structure model is important in the estimation of focal mechanisms for offshore earthquakes, which occur in a more complex structure than the land area. Other than that, as pointed out by Takemura et al. (2021), our study confirmed that the seismic moments estimated using JIVSM are systematically slightly smaller than those estimated by using F-net 1D velocity structure model. The details of our results and ground motion simulations will be presented in the conference presentation.

Acknowledgements
We used F-net waveform data and the F-net MT catalog. The FDM simulations of seismic wave propagation were conducted using the computer system of the Earthquake and Volcano Information Center at the Earthquake Research Institute, the University of Tokyo, and Fujitsu PRIMERGY CX600M1/CX1640M1 (Oakforest-PAC) at the Information Technology Center, the University of Tokyo.

Keywords: CMT inversion, Focal mechanism solution, Kanto region, Long-period ground motion

