Moment tensor inversion of 2016 Southeast Off Mie earthquake via numerical simulation using a three-dimensional velocity structure model

*Shunsuke Takemura[1], Takeshi Kimura[1], Katsuhiko Shiomi[1], Hisahiko Kubo[1], Tatsuhiko Saito[1]

1. National Research Institute for Earth Science and Disaster Resilience

On April 1, 2016, Mw 5.8 earthquake (2016 Southeast Off Mie earthquake) occurred near the epicenter of the 1944 Tonankai earthquake. To investigate seismic activity around the Tonankai area, source mechanism of the 2016 Off Mie earthquake should be required. However, since seawater, accretionary prism (low-velocity sediments) and subducting Philippine Sea plate exist beneath the epicenter region, it is difficult to obtain accurate source mechanism via conventional one-dimensional analysis (Nakamura et al. 2015; Takemura et al. 2016). Thus, in this study, we conduct moment tensor (MT) inversion using Green’s function via finite-difference method (FDM) simulations of seismic wave propagation in a 3D heterogeneous velocity structure model (hereafter, simply called “3D Green’s function”). Recent developments of computer system and calculation technique enable us to evaluate 3D Green’s functions practically.
The model of 3D simulation and technical details are same as in Takemura et al. (2016). The 3D heterogeneous velocity structure, including topography, sedimentary layer, crust and subducting Philippine Sea plate, is referred from the Japan Integrated Velocity Structure Model (JIVSM; Koketsu et al., 2012). By using displacement waveforms for periods of 30-100 s, we estimate an MT solution of this earthquake. The result with minimum variance reduction is the optimal solution with source mechanism and centroid depth.
The optimal result is characterized by a low-angle dipping faulting at a depth of 11 km, where the upper surface of the Philippine Sea plate exists closely. Obtained result reproduced not only long-period displacement waveforms but also polarity of short-period (~ 2 s) *P* waves. Observed *P*-first arrivals at land stations show apparent velocity of approximately 7 km with up polarizations, which propagate along oceanic Moho of the Philippine Sea Plate
Since our FDM simulations evaluated seismic wave propagation for periods longer than 1.4 s, calculation of one element moment tensor at a certain depth requires 1.3 TB of computer memory and a wall-clock time of 1.5 hours by parallel computing using 256 nodes (1,024 cores) of the Earth Simulator.

Acknowledgement
We used the Hi-net/F-net/DONET data and F-net MT solution. The computations were conducted on the Earth Simulator at the Japan Marine Science and Technology (JAMSTEC).

Keywords: Nankai Subduction zone, Earthquake, three-dimensional velocity structure, Moment tensor inversion, Numerical simulation of seismic wave propagation

