Moment tensor inversion of shallow very low-frequency earthquakes around off the Kii Peninsula, Japan: the effects of three-dimensional accretionary prism model

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We conducted moment tensor inversion of shallow very low-frequency earthquakes (SVLFEs) around off the Kii Peninsula, Japan. A set of Green’ s functions was evaluated via finite-difference method (FDM) simulations of seismic wave propagation using the three-dimensional velocity structure model of Takemura et al. (2018). This structural model includes the subducting Philippine Sea plate, crustal structure and bedrock topography from the JIVSM (Koketsu et al. 2012). The three-dimensional accretionary prism model was constructed based on the estimation of S-wave structures beneath DONET stations by Tonegawa et al. (2017). Source grids were assumed on the interface of the Philippine Sea plate at an interval of 0.1°. Cosine-type moment rate function with duration of t s was employed. By using observed velocity seismograms at land-area F-net stations for periods of 20-50 s, we conducted moment tensor inversion of SVLFEs occurred off the Kii Peninsula. The result with maximum variance reduction is the optimal solution with moment tensor, source duration t, centroid location and time.

We validated our method using the SVLFE catalog by Sugioka et al. (2012). In their work, source parameters were determined by using data from ocean bottom seismometers. Although estimated durations and centroid times were different due to different settings for frequency range and meteorology of moment tensor inversion, our solutions of SVLFEs show low-angle thrust faulting solutions similar to solutions by Sugioka et al. (2012). If we use Green’ s functions of the original JIVSM, where the accretionary prism is simply modeled by a single low-velocity layer with V_S = 1 km/s, estimated centroid locations and focal mechanisms were not similar to solutions by Sugioka et al. (2012). Our results indicate that the suitable three-dimensional velocity structure model constructed with the amphibious seismic network enables us to obtain accurate moment tensor solutions of offshore earthquakes recorded by land networks.

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NIED F-net broadband velocity seismograms were used. SVLFE catalog of Sugioka et al. (2012) was downloaded from the website of slow earthquake database. FDM simulations were conducted on the Earth Simulator at the JAMSTEC.

Keywords: shallow very low-frequency earthquake, accretionary prism, moment tensor inversion, 3D heterogeneous subsurface structure, FDM simulation

