Long-Period Ground Motion Hazard Maps in 2009: Hypothetical Tokai Earthquake, Tonankai Earthquake, Miyagi-oki Earthquake

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Long-period (about 2 to 10 s or longer) ground motions have become increasingly important due to the rapid increase in the number of large-scale structures, such as high-rise buildings, oil storage tanks, suspension bridges, off-shore oil drilling platforms, and recent base-isolated structures (Kanamori 1979; Koketsu and Miyake 2008). Damaging long-period ground motions typically originate from large subduction-zone earthquakes. They can generate large long-period ground motions not only in near-fault regions but also in far-source sedimentary basins due to the combination of source, path, and site effects. Long-period ground motions are responsible for some of great earthquake disasters in history. The worst example of destruction occurred in Mexico City 400 km from the 1985 Michoacan earthquake (Mw 8.0). Another example occurred in Tomakomai, a coastal city on the island of Hokkaido in northern Japan, which was hit by long-period ground motion from the 2003 Tokachi-oki earthquake (Mw 8.3) 250 km away (Koketsu et al., 2005; Hatayama, 2008).

Since the source, path, and site effects on the long-period ground motions cannot be accurately evaluated and predicted by empirical methods, long-period ground motion simulations represent one of the most important means for these evaluation and prediction. The simulations have shown that the use of 3-D velocity structures, including sedimentary basins, along the propagation path of the long-period waves is critical for accurate estimation of long-period ground motions. Appropriate source models for subduction-zone earthquakes are also critical for the accurate estimation. Therefore, we first proposed standard procedures of modeling 3-D velocity structures and subduction-zone earthquake sources (Koketsu et al., 2009; Murotani et al., 2008). We secondly constructed the velocity structure and source models for the hypothetical Tokai, Tonankai, and Miyagi-oki earthquakes following the standard procedures. We thirdly performed the numerical simulations of long-period ground motion using these models.

In order to present the results of the long-period ground motion simulations as hazard maps for the three subduction-zone earthquakes, in 2009, we made distribution maps of peak ground velocities, duration of strong shaking, and response velocity spectra at periods of 5 s, 7 s, and 10 s. These are the 'Long-Period Ground Motion Hazard Maps' in 2009. This project has been supported by the Special Project for Earthquake Disaster Mitigation in Tokyo Metropolitan Area, Grants-in-Aid for Scientific Research: Scientific Research (C) & (A), Integrated Velocity Structures Database Project (Special Coordination Funds for Promoting Science and Technology), Integrated Research Project for Itoigawa-Shizuoka Tectonic Line, and Integrated Research Project for Miyagi-Oki Earthquakes.