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Ground motion prediction study in Osaka Plain considering dynamic rupture scenario and 3-dimensional underground structure model

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Active Fault Research Center, AIST(AFRC-AIST) started a project of ground motion prediction for expected future big earthquakes based on realistic earthquake rupture modeling and 3-dimensional velocity structure modeling constrained by geological and geophysical information. We present here a test case for Osaka Plain.

Densely populated sedimentary plains are the places most likely to be damaged by large earthquakes. Among those sedimentary plains, we chose Osaka Plain as our target place, because relatively many surveys for underground structures and active faults have been conducted there by many organizations including the former Geological Survey of Japan. In this study we assume Uemachi Fault as a causative fault. Uemachi Fault is a 45km-long reverse fault running just below the center of Osaka City and accumulating its vertical offset at a speed of 0.4m/Kyear. Rupture of the whole fault plane will turn out to be M7 level earthquake and shake the whole Osaka plain heavily.

Rupture scenarios are generated by numerical simulation of dynamic rupture considering friction law on the fault plane (Kase et al., in this conference). Uemachi fault plane model, consisting of two segments, is assumed based on geophysical survey results, and topographical and geological knowledge (e.g., Sugiyama, 1997; Osaka Prefecture, 1999). We made many simulations varying the unknown parameters such as hypocenter location, stress drop at rupture, and separation distance between the two segments to see the variation of possible scenarios.

For this area, Kagawa et al. (1993) and Miyakoshi et al. (1999) have proposed 3-dimensional sedimentary basin structure models whose layer boundaries are expressed by smooth spline functions. Their models have been widely used in numerical simulations. AFRC is now constructing a 3-dimensional structure model of this area in mesh data style in which sharp offset of faults are realistically expressed (Horikawa et al., in this conference).

Simulations of ground motions generated by the dynamic rupture scenarios in the 3-dimensional structure model were done using 3-dimensional finite difference method (Pitarka, 1999). The simulation deals linear response and the frequency range up to 1Hz. Modeling space expands 35km in EW direction and 55km in NS direction having the Uemachi fault plane model at its center. The simulated ground motions field differ for each scenario due to the hypocenter locations and the rupture propagation directions. Complex spatial variation of ground motion is due to variation of sediment depth, shape of layer boundaries and the interaction between those heterogeneous structure and the rupture propagation direction. Remarkable ground motions are the reflection at Ikoma, Izumi Mountains and at Arima-Takatsuki Fault System, trapped waves at structural concavities below Higashi-Osaka city and below the mouth of Yodo River. We show how the effect of the fault plane geometry, the dynamic rupture processes and the 3-dimensional underground structure influence the ground motion by comparing the simulated ground motions for different rupture scenarios.