Numerical simulation of strong ground motion for the Nankai earthquakes by using the multigrid hybrid PSM/FDM parallel method

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For large scale 3D simulations of strong ground motion, we developed the multigrid PSM/FDM hybrid parallel simulation method. The multigrid method use small grid interval in the upper region and combining with lower region of larger grid size. The multigrid approach for seismic wave propagation simulation in heterogeneous media has already been developed by e.g. Pitarka (1999) and Aoi and Fujiwara (2000) for FDM simulation, and the efficiency of the scheme over traditional FDM modeling using constant grid size has been demonstrated by many researchers. So we also applied this for our (Furumura et al. 2000, 2002) PSM/FDM hybrid method using an accurate interporation/extraporation using the Fourier transform and a special FDM operator for irregular grid intervals.

To demonstrate the efficiency of the muitigrid modeling, we have conducted numerical 3D simulation of Nankai megathrust earthquakes. The 3D model is 1288km by 644km by 150 km, which is discritized by small grid size of 1.2km*1.2km*0.6 km in upper 6km layer and a double grid size is used in lower layer. The 3D crust and upper mantle structural model is based on number of studies on Vp and Vs structure of southwestern Japan (e.g., Omi et al., 2001; Furumura and Koketsu, 2002; Ryoku, 1999; Ishida, 1989). Source model for the 1944 Tonankai earthquake is derived from an analysis of strong motion record (Kikuchi and Yamanaka, 20000). The simulation took computer memory of 9GB and CPU time of 2 hours by parallel computing using 128 processors of HITACHI SR8000. The simulation result shows large ground motion distribution of seismic intensity 3 or larger along the coast from Enshnada to Surugawan, which agrees well with observations. Comparisons between the simulation results using the different structural model indicate that the low-velocity superficial layer amplify the ground motion of intensity order of 0.5 to 1 relative to the rock site.