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Re evaluation of the elongation of the long period ground motion due to Nankai Trough earthquake which occurs by linkage

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We examined the characteristic of the long period ground motion expected for future Nankai Trough earthquake by comparison of observed ground motion during the 2011 Off Tohoku Mw9.0 earthquake and comparison in recent destructive Nankai Trough earthquakes in 1944 and 1946.

A large and long-time shaking of long-period ground motion was developed during the 2011 Off Tohoku Mw9.0 earthquake due to the fault rupture in wide area of about 500 km ∗ 200 km and slip of over 20m entirely over the plate interface. In addition, very large slip of more than 50 m occurred near the Japan Trench might cause very long period ground motions with period over 10 sec. Ground motion record from dense seismic array across Japan demonstrated that the large slip occurred at least two or three area on the fault plane with time lag for tens of seconds, leading multiple shocks of strong ground motions with long-time durations more than 10 min.

Mzximum amplitude of the velocity response spectrum of the long-period ground motions observed in central Tokyo (Kanto basin) is about 40 cm/s in wide period band from 0.5 to 40 sec, which is considered to be rather weak for Mw9.0 earthquake since it was almost comparable to those observed during Mid Niigata Mw6.8 earthquake in 2004 and SW Off Kii-Peninsula Mw7.4 earthquake. It is considered that the level of long-period ground motions developed in central Tokyo is usually very weak from the earthquakes occurring in the area off Miyagi because the long period surface waves cannot effectively developed in the structure of Japan Trench. On the other hand stronger long-period ground motion is often developed in the Nankai Trough where thick cover of acritional prism over subducting Philippine-sea plate develop and guide long period ground motion along the trench very effectively.

Therefore it is expected that the development of the long-period ground motion for future Nankai Trough earthquake should be much stronger than those observed during the present Off Miyagi earthquake. In addition, linkage occurrence of the Tokai, Tonankai, and Nankai earthquake segment with time lag of several tens of second between each segment prolong duration of long period ground motions as noted during the present Off Miyagi earthquake. Such effect of long-time shaking should cause significant influence to high-rise building with resonance to the long-period ground motions for long time. Since the duration of the long-period ground motion is not noticed in the present index of shaking such as intensity, peak ground velocity, and response spectrum etc., we need introducing additional index such as cumulative elastic energy etc. to evaluate the possible dangerousness of long-time shaking of the long-period ground motions expecting for linkage earthquake occurences.

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