Strong motion and tsunami prediction for the Tonankai and Nankai earthquake

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The Tonankai earthquake and the Nankai earthquake are most probable to occur in the first half of this century. In case that the two M8 class events occur simultaneously, severe damages will be estimated in very wide area from Kanto to Kyushu region. The Specialist Investigation Committee, under the Central Disaster Management Council, made a close study on the source characteristic, strong ground motion, and tsunami from the events.

(1) Object

The magnitude, mechanism, and process of earthquake occurrence show a wide variety. On the stand point that the common consent with regard to the countermeasure is most important, the maximum ground motion intensity and tsunami height ever experienced in each region are most optimum of the hazards to be accounted for. The following three cases are studied; the Tonankai+Nankai earthquake, the Tonankai earthquake, the Nankai earhtquake. Two other cases are also studied; the Tokai+Tonankai+Nankai earthquakes, and the Tokai+Tonankai earthquake. Most recent achievements in earthquake and earth structure related sciences and large amounts of accumulated data are based on in the study.

(2) Strong motion sources

The Tokai earthquake source is already modeled. so as to fit the intensity distribution of the past events by the Specialist Investigation Committee for the Tokai earthquake. The strong motion source of the Tonankai and Nankai earthquakes are modeled in the same manner, the model from the Headquarters for Earthquake Research Promotion being referred to. The source area of the Nankai earthquake to some extent extends westward, and that of the Tonankai earthquake eastward. The source is modeled with small patches along the Philippine Sea plate.

(3) Subsurface structure

The three-dimensional structure between the seismic base (Vs=3,000m/s) and engineering base (Vs=700m/s) is modeled by using geotechnical, borehole, and geolobgical data, and is verified by using the strong motion records and geotechnical data. The structure shallower than the engineering base is modeled at each 1km standard grid point according to borehole and geomorphological data.

(4) Strong motion prediction

Stochastic Green's function method combined with Irikura's synthetic method (1983, 1986) is used. Seismic waves are synthesized at the engineering base for each 1km grid. The surface layer effects are evaluated by one-dimensional non-linear response algorithm. The empirical method is also used.

(5) Tsunami sources

Tsunami source areas and fault displacements are obtained by inversion technique using historical tsunami height data. Tsunami source of the Nankai earthquake extend westward compared to strong motion source.

(6) Topography

Topography is modeled by the digital mesh data in the ocean, and by digital map in the land. For rivers, the geodetic survey data are used. The friction effect is accounted for by the Manning's roughness coefficient.

(7) Coastal constructions and banks

Coastal constructions are located according to the lists of each prefecture and set at the grid boundary. River bank are also modeled at the grid boundary referring to figures from Ministry of Land, Infra-structure and Transportation.

(8) Tsunami prediction

Crustal movement as the source is calculated from the tsunami source model. Tsunami propagation is simulated by the finite difference method. Long period linear theory is applied to the deep sea, and non-linear theory to the shallow part and to the land. The smallest grid size is set to 50m.

(9) Results

If the Tonankai and Nankai earthquake occurs simultaneously, the wide areas from Shizuoka Prefecture to Kyushu island suffer JMA ground motion intensity scale 6- or more and tsunami height 3m or more. In considerably wide areas, intensity of 6+ and tsunami height of more than 5m are predicted. The results of investigation are used as the criteria to designate the Area for Earthquake Disaster Prevention Countermeasures.