

Long-Periods Ground Motions of the Tokyo Bay Area from Two Large Events of the East of Kuril Islands

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Tokyo Electric Power Company has started observation of long-period ground motions at the thermal power stations using broad-band velocity type seismometers in order to study long-period ground motion characteristics at the site. The VSE-355G3 seismometer (frequency range 0.012 - 100Hz) was adopted for the observation and seismometers were installed to thermal power stations in the Tokyo bay area, Ibaraki prefecture and Fukushima prefecture.

Two large earthquakes of M 8 classes ($M_j=7.9$ and $M_j=8.2$) occurred in the east of Kuril Islands in November 15, 2006 and January 13, 2007. The epicentral distances of these events from the stations in Tokyo bay area are over 1700 km but all stations retrieved the ground motion records from these events. The recording time at several stations exceeded 5000 seconds. In this paper, the records from both events were compared and examined about the cause of the difference in the frequency range from 0.01 to 1.0 Hz.

The waveforms from the event in January have larger amplitude than those of the event in November and show rich of high frequency ground motions. The Fourier spectra of the records of Kashima station [Epicentral distance: 1630km for the November event and 1710km for the January event] show wide peak in frequency between 0.03 and 0.2 Hz in both horizontal and vertical components for both events. The peak frequency of spectra from the November event located at about 0.6 Hz but that from the January event is about 0.1 Hz. The Spectral ratio of the January event to the November event has a factor four peak at about 0.1 Hz and 0.3 Hz for both horizontal and vertical components. The spectral ratio value in horizontal components rises from 2 at 0.45 Hz to 7 at 1 Hz and that of vertical component shows the peak of factor 4 at 0.5 Hz. The results of multi-pull filtering analysis show the dispersion characteristics of observed records. The wave groups that have power at 0.1 Hz are delayed from arrival of wave groups that have power at 0.05 Hz.

As for the waveforms of the stations around the Tokyo bay area, the amplitude of later arrivals were bigger than those at Kashima station where is nearer to the epicenters. This tendency is more remarkable in the January event than the November event and especially at the observation stations on the east side of the Tokyo bay. The waveforms at the site on the east side have more significant later arrivals than those of west side. The Fourier spectra of records at the Tokyo bay area have a wide peak between 0.03 and 0.2Hz as well as Kashima station. Spectral ratios reference to Kashima station show that remarkable peak at 0.1 Hz is observed in the east side stations but not observed at the sites on the west side. As for this remarkable peak at 0.1 Hz, the peak values of the January event are a little higher than those of the November event.

The difference of waveforms between the November event and the January event are caused from the difference at frequency of 0.1 Hz in frequency domain. This difference is appeared at Hirono station where is nearer to epicenter than Kashima station. It may be caused from source effects or propagation path effects. The result of the multi-pull filter analysis suggests that the higher mode surface wave affect the difference of waveforms. Large amplification on the east side of Tokyo bay at around 0.1 Hz was already pointed out after the record from the 2004 Off Kii Peninsula earthquake and are caused from the effects of underground structure. Effects of input wave field and the site effects piled up, and made large later arrivals in the waveforms at the sites on east side of Tokyo bay from the January event. The amplification rates at 0.1 Hz evaluated from two events is different. It suggests that the relative amplification factor can be changed for different mode of surface waves.