Long-period strong ground motion of the Tokyo Bay area during the events occurred in the plate triple junction area

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Uetake (2018) analyzed the velocity records of the Tokyo Bay area during the M6.7 earthquake of September 23, 2016 occurred in the north side of the plate triple junction. The velocity spectra of these data showed that the short period component was small and the component with the period of 10 seconds was large comparing with the records observed during the same magnitude events and at almost same distance. After that, in the south side of the triple junction area, two M5.9 earthquakes occurred on December 24, 2018, and one M5.7 earthquake occurred on December 25, so we have compared these earthquake records with those of the 2016 event. Furthermore, we tried to compare to the records of the north side events along the Japan Trench.

First, we analyzed the characteristics of the records from the M5.9 earthquake occurred at 9:18 on December 24, 2018. We used the records obtained by the broadband velocity type strong-motion seismograph installed in the thermal power plants on the Tokyo Bay shore. Four observation stations exist on the east coast of the Tokyo Bay and eight observation stations exist on the west coast. The epicentral distance is from 210 to 230 km for the observation points on the east coast and Yokosuka. The epicentral distance is from 230 to 240 km for the observation points on the west coast except for Yokosuka. Long-period ground motion continued for a long time in the velocity traces at any observation point, and the significant wave packets are recognized especially at observation stations in the northeastern coast of Tokyo Bay. The velocity response spectrum with damping of 5% were calculated from observed data, there is a peak at around 10 seconds in period at any observation station, and the short period side is small. The amplitude of the spectra at period of 1 to 2 seconds is under one-fifth of amplitude at period of 10 seconds. A clear group dispersion was recognized in the waveform of the northeastern coast of the Tokyo bay by the multi-pass filter analysis, this means that the surface wave component was dominant. These features are similar to the M6.7 event in 2016. A similar tendency can also be confirmed with the M 5.9 event at 9:43 on December 24, 2018 and the M5.7 event on 25 December 2019.

Next, we compared the ground motions of the 2018 events with those of the events occurred in the north side of the plate triple junction along the Japan Trench. The events with M 5.7 or more occurred in the south area from 35.5 degrees north latitude in 2008 to 2018 were selected. There are few occurrences of large earthquakes in this area, and the next 4 events were selected. M 5.5 on May 2, 2013, M 6.1 on March 12, 2011, M 6.0 on April 14, 2011 and M 5.9 on 23 December 2013 in order from the south. Examining the characteristics of the velocity response spectrum with damping of 5% of these events, the velocity response spectra of the event on May 2, 2013 shows a similar shape to the events in the vicinity of the triple junction, but those of the other three events show different shape. The velocity response spectra of these three events are large in the short period side and almost the same amplitude in the period range from around 2 seconds to 10 seconds as shown in figure. This suggests that there is a regionality in the seismic source characteristics of the earthquake along the Japan Trench.

Keywords: Long-period strong ground motion, Surface waves, Source characteristics