

Source of the 1923 great Kanto earthquake explaining observed tsunami waveforms

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One of the most devastating natural disaster in Japan was caused by the 1923 great Kanto earthquake occurred just beneath the Tokyo Metropolitan area. The number of casualties by the earthquake was more than 100,000. The number of injured people was reached 2 million. In the southern Kanto region where the Philippine Sea plate is subducting along the Sagami trough, great underthrust earthquakes of M7-8 have repeatedly occurred. They also generated large tsunamis. It is, therefore, important to investigate the generation mechanism of large tsunamis that occur in such areas.

The 1923 Kanto earthquake is the most recent great earthquake along this plate interface. Source models for the 1923 event have been studied by many researchers using seismological and geodetical data. Aida (1993) proposed source models of the 1923 earthquake using regional tsunami heights from historical documents and experiences at the time of the earthquake. Namegaya et al. (2011) constructed a fault model consists of 34 subfaults and estimated the slip distribution by inversion of the co-seismic vertical deformation. Tsunami waveforms generated by the 1923 earthquake were also recorded by several tide gauges along the Pacific coast in Japan and reported by the Imperial Earthquake Investigation Committee (1926). However, those data have not been analyzed to estimate the source of the earthquake.

In this study, we used those variable tsunami waveforms to study the source of the earthquake. First, we digitized historical tsunami waveforms recorded at ten tide gauge stations, Ayukawa, Minatomachi, Choshi, Osaka, Owase, Kushimoto, Urado, Tokyo bay (Chiba, Shibaura, Fukagawa). Next, we needed to correct the bathymetry of Tokyo bay because the bay has been reclaimed significantly since the time of the earthquake. Finally, tsunami numerical simulation was conducted using previously proposed two source models (Aida,1993; Namagaya et al., 2011). Then, the computed tsunami waveforms at tide gauges were compared with the observed ones. The results of the comparison showed that computed tsunami waveforms from the source model estimated by Aida (1993) tended to overestimate the amplitude of observed waveforms. In Tokyo bay near the epicenter, computed waveform showed twice the amplitude of the observed waveform. On the other hand, the computed tsunami waveforms from source model estimated by Namegaya et al. (2011) well explained the observed tsunami waveforms. Especially at Tokyo bay, Minatomachi and Urado, the computed tsunami heights explained the observed heights much better than those computed from the Aida model.

This result indicates that the tsunami generation due to the 1923 great Kanto earthquake was a typical co-seismic vertical deformation caused by the earthquake.

Reference

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Keywords: Tsunami numerical simulation, the 1923 Kanto earthquake