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Numerical simulations of tsunami associated with the Sanriku-oki earthquake on December 7, 2012

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An earthquake with magnitude 7.4 occurred off Sanriku on December 7, 2012. According to seismic waveform analysis, this earthquake consisted of two subevents. The first subevent was reverse fault type (M 7.2) followed by the second normal fault type subevent (M 7.4), which occurred eight seconds after the first event. Tsunami waveforms generated by the earthquake were recorded at some tide gauge stations along the Pacific coast of the Tohoku district. In this study, we performed numerical simulations of tsunami associated with the earthquake, and compared the results with the observed tsunami waveforms. We used the fault parameter and epicenter location determined by Japan Meteorological Agency. The slip of the fault plane was assumed to be uniform. Firstly, we calculated tsunami waveforms, by assuming the second subevent alone, which is considered to contribute tsunami waveforms remarkably. The calculated result which was obtained assuming the linear shallow water equations was compared with tsunami waveform at the Soma tide gauge station operated by the Geospatial Information Authority of Japan. The calculated first tsunami wave turned out to be a backwash, which was the same sense as the observed waveform. However, the calculated amplitude was quite large and differed from the observed waveform remarkably. Secondly, assuming the two subevents, we performed numerical simulation. Although amplitude became somewhat smaller than that of the above-mentioned result, calculated wave height was rather different from the observed one. The peak of the first waveform of the observed tsunami was also larger than that of the trough, which was not able to be reproduced by the simulation. When the nonlinear shallow water equations were assumed, the amplitude of the calculated tsunami became small slightly. However, the feature of the observed first waveform was not able to be reproduced. Furthermore, we performed numerical simulations, imposing coseismic slip distributions on divided small subfaults for the two subevents, which were obtained by Japan Meteorological Agency using an inversion analysis of seismic waveforms. Although the tsunami wave height calculated by using this model was still larger than the observed one, the calculated result became close to the observed one. In the calculated results, the amplitude of the peak in the first waveform became larger than that of the trough, which is similar to the observed waveform. We will compare our simulated results with the observed tsunami waveforms at other tide gauge stations along the Pacific coast of the Tohoku district.

Keywords: 2012 Sanriku-oki earthquake, tsunami, numerical simulation