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Seismic waves and tsunami excited by an anticipated Nankai-Trough earthquake: Evaluation for near-source sea-surface displacements

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Recent development of offshore observation technology will provide us with tsunami records above the earthquake focal area. By using these records, we will be able to detect tsunami more rapidly and to predict coastal tsunami reliably. However, it should be noted that this new observation will bring us a new problem. Because seismic waves coexist with tsunamis in that area, the seismic waves can work as noise for tsunami signal. In order to conduct tsunami analyses correctly for those records, we need to take both seismic waves and tsunamis into account for the waveform analysis. In this study, we propose a new method to compute sea-surface height change caused by both seismic waves and tsunamis. Our simulation results indicated that the seismic waves contaminated the sea-surface height records (red lines in Figure 1), although most of the past tsunami studies had neglected this contribution. Besides, we computed the sea-surface height records and high-resolution inundation for a rupture scenario of a huge earthquake that possibly occur in the Nankai Trough, Japan (Hok et al. 2011 J. Geophys. Res.). By using these synthesized records, we evaluated the performance of a real-time tsunami prediction algorithm proposed by Inazu et al. (2016 Geoscience Letters). The method could reliably estimate the initial tsunami height distribution ~10 min after the earthquake occurred. Finally, we discussed the similarity and difference between sea-surface displacement record and sea-bottom pressure change record. Although seismic waves appear in both records, the contribution of seismic waves was smaller in the sea-surface displacement than in sea-bottom pressure change.

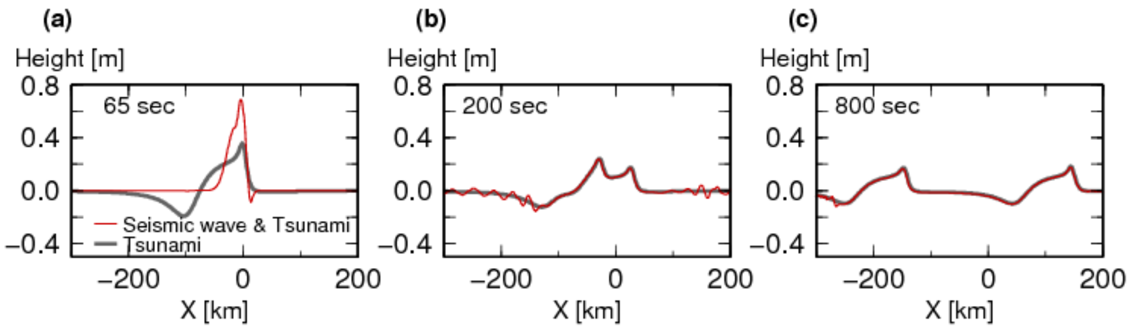

Figure 1. Sea-surface height distributions for various elapsed times ((a) 65 s, (b) 200 s, and (c) 800 s from the origin time) caused by an earthquake. The slip on the fault is 1 m, the fault width is 100 km (ranging from ~ –100 km to 0 km in the x axis), the dip is 15 degrees, and the shallowest part of the fault is located 5km below the sea bottom. Red lines are the simulation results including both seismic wave and tsunami. Gray lines are the results including only tsunami.