

Estimations of tsunami by the Nankai Trough Earthquake that a vessel encounters in Hanshin Port.

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Nakada *et al.* (2015) simulated the tsunami caused by the Nankai Trough Earthquake based on the case 3 fault model. Osaka Bay was divided into a 50 m grid horizontally in the model with one vertical dimension. And the flow speed and height of the tsunami was calculated for every 0.5 seconds from the earthquake occurrence to 600 minutes. Then the vorticity was calculated by the flow speed (Hayashi *et al.*, 2016). Hanshin Port located in the inner part of Osaka Bay is the international strategic port. Because ocean shipping is a important infrastructure, a vessel evacuation procedure for a tsunami should be planned. The Kobe Marine Casualty Prevention Institute (2013) created a recommended evacuation area map from tsunami for vessel in Osaka Bay. The Kinki branch of Ministry of Land, Infrastructure, Transport and Tourism, Japanese Government (2014) provided the guidelines to create a manual on tsunami evacuation for operators of vessels in Osaka Bay. Detail of tsunami around the mooring pier should be understood in order to plan the evacuation procedure from a tsunami in each vessel. There are petrochemical complexes around the port of Sakai-Senboku, and various vessels enter. The spatial average of the vorticity of the tsunami vortexes in whole of Osaka Bay was at its maximum at 117 minutes after the earthquake occurrence. The vorticity at the entrance of Sakai Passage of the port of Sakai-Senboku is more than $3.2 \times 10^{-3} \text{ s}^{-1}$ at its maximum, and is maintained at more than $2.0 \times 10^{-3} \text{ s}^{-1}$. The size of the average vortexes at the entrance of Sakai Passage is longer than the length of a vessel. The location and the revolution direction of vortexes are decided in a place. And the high correlation between the magnitudes of vorticities generated by the tsunami and tidal currents was found. Therefore the tsunami vortexes can be deduced from the tide simulation.

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