

Offshore tsunami observation array suitable for coastal tsunami prediction using multiple linear regression with L1 regularization

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In recent years, tsunami prediction methods using the offshore tsunami data are investigated while high-density offshore tsunami observation networks have been deployed around Japan. We proposed methods to predict the coastal tsunami height by regression from offshore tsunami heights in the previous studies (Baba et al., 2014; Igarashi et al. 2016). These aimed to utilize the tsunami data observed by previously installed offshore gauges to improve the accuracy of tsunami prediction at the coast as possible. On the other hand, considering a development of a similar system including construction of a new offshore observation network in other area, we have to answer a question where we should install observation points to make the prediction accuracy the best. Therefore, in this study, the importance of each offshore observation point was evaluated by introducing L1 regularization term (LASSO) in the regression analysis. This study was carried out by the following procedure. We assumed 2622 rectangular fault models in total in the Nankai trough subduction zone. Uniform sliding was assigned for 1506 models. The remaining 1116 models have heterogeneity of slip distribution by assuming a large slip patch on the fault plane. The tsunamis caused by the 2622 fault models were repeatedly calculated by solving the nonlinear long wave theory. We performed a multiple linear regression analysis with L1 regularization term to the maximum tsunami heights at a point in the Asakawa bay, Tokushima, and these recorded at the 57 offshore points of GPS wave meters and the DONET water pressure gauges. The analysis showed that it is possible to predict the coastal tsunami height with the accuracy of RMS residual less than 1 m by using only 12 offshore points which are located in the Kii Channel between the Cape Shiono and the Cape Muroto.

Keywords: tsunami prediction, offshore observation, L1 regularization term