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# Examination of algorithms toward real-time tsunami forecast using ocean bottom pressure data

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We are developing a method toward a real-time forecast of the tsunami inundation as well as the coastal tsunami heights using the real-time data observed by the Seafloor Observation Network for Earthquakes and Tsunamis along the Japan Trench (S-net; Uehira et al., 2015) and are constructing a prototype system that implements the real-time forecast method for the Pacific coast of Chiba prefecture (Sotobo region) (Aoi et al., 2015). In this study, we examine an algorithm for the real-time forecast using the data from the ocean bottom pressure gauges of the S-net. We employ the database-based method to forecast the inundation, which is a nonlinear phenomenon, for relatively broad region. We use the densely observed data set probably including the data obtained in or close to the tsunami source area to perform the rapid and precise tsunami forecast. The database is called as ”Tsunami Scenario Bank” in this study and includes ”Tsunami Scenario” composed of the possible tsunami source model, and the simulation results of the ocean bottom pressure data at S-net observation stations, coastal tsunami heights, inundation areas, and flow depth if inundation will occur, for each of the source models. Triggered by an earthquake or tsunami, the algorithm starts to search scenarios whose ocean bottom pressure data match the observed data reasonably well. Selected scenarios from this matching then provide the information of forecasted tsunami heights, inundation areas and flow depth, adequately considering the uncertainties of the forecast. Ideally, uncertainty of the forecast information becomes small as the tsunami generation and propagation are well captured by widely deployed seafloor observation network.

One of our examined algorithms selects scenarios by evaluating the match of the spatial distributions as snapshots between the observed and scenario offshore pressure data using multiple indexes (Yamamoto et al., 2014). The indexes for evaluation are the correlation coefficient of the observed and scenario pressure amplitudes, geometrical mean and geometrical standard deviation of the ratio of the observed to scenario data. Use of multiple indexes provides more robust scenario selection or tsunami forecast than use of single index. We also examine the two variance reductions whose L2-norm part is normalized either by the observed data or by the scenario data. The variance reduction with the normalization by the observed data is sensitive to the overestimation of the forecasted tsunami while that by the scenario data is sensitive to the underestimation. Use of both variance reductions together has a potential to more robustly constrain the size of the generated tsunamis. In addition to the above algorithm that evaluates the spatial snapshots of the tsunami propagation, we will further examine another approach that uses the time history of the tsunami waveform itself.

Keywords: Real-time tsunami forecast, Tsunami inundation, Scenario bank, S-net