Improvement of Real-time Tsunami Forecast System for Outer-rise Earthquake

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The outer-rise earthquakes often induce the behavior of the unusual tsunamis. For example, it induces an abnormally larger tsunami than expected from its seismic ground motion, called tsunami earthquake and/or contains short wavelength components produced by sea floor displacements caused by shallow depth fault slip. Additionally, the depressed wave usually arrives preceding the first elevated wave for the normal fault earthquake tsunamis. National Research Institute for Earth Science and Disaster Resilience (NIED) has developed real-time tsunami inundation forecasting method using real-time ocean bottom pressure data taken by the dense offshore observation network such as the Seafloor observation network for earthquakes and tsunamis (S-net) that has been constructed along the Japan Trench (Chikasada et al., 2019, Technical Report of NIED; Yamamoto et al., 2016, EPS). They calculated synthetic tsunami waveforms at the observation locations by solving nonlinear long-wave equations using a staggered leapfrog finite-difference scheme. A run-up boundary condition was applied to the coastal regions and an open boundary condition was applied to the rims of calculation region. But they did not consider about dispersive wave (Baba et al., 2017, Ocean Modeling) neither the attenuation effect of ocean bottom pressure changes (Chikasada et al., 2018, AGU).
Therefore, we reconsidered the effects of the dispersion term and the attenuation for a few thousands tsunami scenarios stored in the Tsunami Scenario Bank (TSB). As a result, we confirmed that these two effects possibly cause underestimation in real-time tsunami forecast. Therefore, we need to update waveforms calculated and registered for outer-rise earthquake into the TSB with a dispersion term. However, it is quite time-consuming task to solve non-linear long-wave equations with Boussinesq terms. In order to reduce calculation time, the linear long-wave equations with Boussinesq terms could be used to generate offshore synthetic waveforms. We considered the attenuation effect as well.
This work was partially supported by JSPS KAKENHI Grant Number JP15H05718 and JP18K04674.

Keywords: Tsunami, Outer-rise earthquake, Ocean bottom pressure observation

