

Real-time tsunami prediction in a coastal zone, using a superposition of Green' s function

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Recently, S-net (Seafloor observation network for earthquakes and tsunamis along the Japan Trench) and DONET 1 & 2 (Dense Oceanfloor Network system for Earthquakes and Tsunamis) are installed off the Pacific Ocean, Japan by NIED (National Research Institute for Earth Science and Disaster Resilience) and JAMSTEC (Japan Agency for Marine-Earth Science and Technology); therefore, real-time tsunami forecasting methods using directly tsunami data observed in oceanfloor are proposed (e.g. Yamamoto, 2016; Tanioka, 2018). In this study, focusing on the immediacy and the robustness of tsunami forecasting, we investigated real-time tsunami prediction method in a coastal zone, using a superposition of previously calculated Green' s function.

In this method, we divide the entire source area of tsunami into element sources (for example, 50 km x 50 km), and we, in advance, calculate the Green' s function to a coastal point for the unit tsunami water level (1 m) in the element source. Assuming that the tsunami water level is the same within the element source when a tsunami occurs, we the Green' s function to the element source –the coastal point for the maximum value of the tsunami water level observed at one point in the element source. By applying this to all the divided element sources and superimposing these Green' s functions, we can obtain the tsunami water level in a coastal zone for the entire source area. Comparing the result predicted by this method to a tsunami simulation result simulated from source model proposed by the Cabinet Office, Government of Japan, for the 2011 off the Pacific coast of Tohoku earthquake, we confirmed that two results are in good agreements.

Moreover, to use the amount of tsunami water level in the source area due to heterogeneous fault rupture, we investigated the possibility to replace the time series of tsunami data observed at a point in the element source with the amount of tsunami water level within the element source area. We confirmed that the time series of tsunami data can be used for real-time tsunami prediction using a superposition of Green' s functions by appropriately estimating the time when the tsunami propagates within the element source.

Keywords: Real-time tsunami prediction, Green' s function, Superposition, 2011 off the Pacific coast of Tohoku earthquake