Earthquake and tsunami forecasting procedures using large number of simulation scenarios

*Takane Hori[1], Yasuhiko Igarashi[2], Masato Okada[2]

1. R&D Center for Earthquake and Tsunami, Japan Agency for Marine-Earth Science and Technology, 2. Graduate school of frontier science, the University of Tokyo

Recent progress in earthquake and tsunami simulations, we can calculate many scenarios for earthquake generation patterns and tsunami propagation patterns. For earthquake forecasting procedure, we propose a method that is based on spatio-temporal variation in slip velocity on the plate interface, which causes interplate earthquakes (Hori et al., 2014). Model outputs are not only information about the occurrence of great earthquakes (time, place, and magnitude) but also information about the physical state evolution that causes earthquakes. To overcome the difficulty in forecasting earthquake generation resulting from uncertainty both in the physical model and in the observation data, we introduce a type of sequential data assimilation. In this method, we compare observed crustal deformation data to simulations of several great interplate earthquake generation cycles. We are currently constructing a prototype, applying this forecasting procedure to the Nankai Trough, Southwest Japan, where great interplate earthquakes have occurred and are anticipated. On the other hand, for tsunami hight forecasting, we constructed a model to forecast the maximum tsunami height by a Gaussian process (GP) that uses pressure gauge data from the Dense Oceanfloor Network System for Earthquakes and Tsunamis (DONET) in the Nankai trough (Igarashi et al., 2016). We studied the relationship between offshore and coastal tsunami heights with the aim of using DONET1 ocean-bottom pressure gauges for tsunami prediction. We assumed various tsunami models, including fault models and tsunami sources, and created a large number of simulations (more than 1,500) to reveal the relationship between DONET1 ocean bottom pressure gauge measurements and coastal tsunami heights. We found a greatly improved generalization error of the maximum tsunami height by our prediction model. The error is about one third of that by a previous method, which tends to make larger predictions, especially for large tsunami heights (>10 m). These results indicate that GP enables us to get a more accurate prediction of tsunami height by using pressure gauge data. We will further develop both earthquake and tsunami forecasting procedure using data driven science and high performance computing technology.

