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Tsunami hazard assessment project in Japan

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Tsunami hazard assessment (THA) is the most important information to take effective measures against possible tsunami attacks in future. After the national tragedy caused by the 11st March 2011 Tohoku earthquake (Mw9.0), NIED started a research project regarding TSA in Japan to support various kind of measures by sectors such as local governments, life-line companies, etc (Fujiwara et al., 2013, JpGU). Our research project consists of two components; (A) a research of probabilistic tsunami hazard assessments (PTHA) in which we consider all of possible tsunamis that may affect coastal regions in future and (B) a research to forecast coastal tsunami heights and inundation flow depths based on specified earthquake scenarios.

In the research (A) of PTHA, we began working on subjects of (1) nation-wide probabilistic tsunami hazard assessment (NW-PTHA) and (2) detailed probabilistic tsunami hazard assessment for a specific region (DPTHASR). Outlines of (1) NWPTHA are as follows; (i) we consider all of possible earthquakes in future including earthquakes that the Headquarters for Earthquake Research Promotion (HERP), Japanese Government, already assed. (ii) We construct a set of simplified earthquake fault models, called ″ characterized earthquake fault models (CEFMs) ″ , for all of the earthquakes mentioned above by following prescribed rules (Toyama et al., 2014, JpGU; Korenaga et al., 2014, JpGU). (iii) We solve a non-linear long wave equation, using staggered leap-flog, finite difference method (FDM), including inundation calculation as coastal boundary condition, over a nesting grid system with the minimum grid size of 50 meters, to calculate tsunamis for each of initial water surface distributions (under research for initial water surface calculation by Akiyama et al., 2014, JpGU) generated from a large number of the CEFMs. (iv) Finally we integrate information about coastal tsunami heights from the numerous CEFMs to get nation-wide tsunami hazard curves, defining excess probability, for coastal tsunami heights, incorporating uncertainties inherent in tsunami forward calculation and earthquake fault slip heterogeneity (Abe et al., 2014, JpGU). In the present step we are revising a prototype of NWPTHA in the case where possible tsunami sources are located along the Japan Trench as well as we are constructing a set of CEFMs in the case where possible tsunami sources are located along the Nankai Trough.

As for the research of (2) DPTHASR, we are going to develop new methods to assess inundation probability and inundation time, etc., through tsunami inundation simulations for a set of CEFMs using the same FDM over a nesting grid system with the minimum grid size of 10 meters including information of seawalls and breakwaters. Some of results from DPTHASR will be represented in a similar format of ″ Karte ″ (medical chart) to help understandings of tsunami hazard information by residents. In the present step, we are constructing a new method to assess probabilistic inundation depth distribution along with calculation of hazard curves for inundation depth at specified points on land (Saito et al., 2014, JpGU).

In the research (B), we are planning to construct a deterministic method to forecast coastal tsunami heights, inundation area and depth, etc. in specified sites in the scenarios that possible maximum-sized tsunamis strike there. These deterministic forecasts should be examined through comparisons with tsunami deposits distribution, historical materials, and instrument records.

Also, we are making a lot of effort to utilize probabilistic and deterministic tsunami hazard information by investigating actual usages of domestic/oversea tsunami hazard information (Osada et al.,2014, JpGU) and by investigating opinions and ideas from persons-in-charge of measures by local governments for tsunami disasters thorough questionnaire surveys with direct interviews (Ohsumi et al., 2014, JpGU).

This work partially functions to support activities of HERP.

Keywords: tsunami, hazard assessment, probability, scenario-type tsunami forecast, hazard map, utilization