Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HSC24-P09 Room:Convention Hall Time:May 24 18:15-19:30

Preliminary approach of probabilistic tsunami hazard assessment for the Japan trench earthquakes

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National Research Institute for Earth Science and Disaster Prevention(NIED) has started an research project on probabilistic tsunami hazard assessment(PTHA) around Japanese coastal area since 2012(e.g. Fujiwara et al., 2013JpGU, Hirata et al., 2014JpGU). In this presentation, we shortly report preliminary results on PTHA study for a set of the possible tsunami-genic earthquake along the Japan Trench.

Outline of our PTHA scheme is as follows: I) Occurrence probabilities set for all of possible tsunami-genic earthquakes under appropriate assumptions, such as "Evaluation of occurrence probability of earthquakes" by the Headquarters for Earthquake Research Promotion(HERP, 2011), Japan. II) Characterized earthquake fault models(referred as tsunami source models, hereafter) for hypothesized earthquakes are built up, in which we take account heterogeneities on slip distributions. III) Terrain on land and subsea is modeled with the finest resolution of 50 meters. IV) Coastal tsunami height is estimated numerically through surface deformation by Okada's formula (Okada, 1992) and finite-deference scheme based on non-linear shallow-water equation. In calculation, land-ward inundation is allowed, and transparent boundary condition is applied for sea-ward boundaries. V) Thirty-years exceedance probabilities on tsunami height are estimated at every coastal grid with event occurrence probabilities and areatory uncertainties due to numerical assumptions and limitations (Abe et al., 2014JpGU, Korenaga et al., 2014JpGU).

We consider subduction type earthquakes (inter-, intra-plate earthquakes and tsunami earthquakes) at the Japan Trench, in which include both earthquakes described in the long-term evaluation for the Japan Trench by HERP (2011) and those without evaluations. All of tsunami source models consist of background slip area and one or two large slip zone (LSZ), where LSZ is defined as area where slip amounts is two times larger than average slip. If LSZ would be modeled at very shallow zone of subducting plate, quad-time slip zone will be added into slip model. Areas of LSZ and quad-time slip zone are 30% and 10% of the total fault area, respectively. For models with Mw8.3 and more, we take account several slip distribution scenarios on one source because slip distribution would be not always the same even in same fault area. Tsunami sources with moderate to relatively small size are modeled that fault is distributed uniformly on the surface of subduction plate up to about 60km, and single LSZ is set at center part of each fault. Source size and its seismic moment are estimated through an empirical relationship (Toyama et al., 2014JpGU). Finally, we have conducted tsunami forward calculations for 1890 scenarios whose earthquake magnitude had ranged from Mw7.0 to Mw9.4.

We adopt two sort of probabilistic earthquake occurrence models; first is a hybrid model of BPT (Brownian Passage Time) process and Poisson process. Second model is the Poisson model, in which all scenarios would assume to be occurred at random temporally. In both cases, return periods for earthquakes with HERP's long-term evaluations are the same as the HERP, and frequencies for earthquakes without HERP's evaluation are taken from G-R law with b=0.9. Resultant hazard curves for the Pacific coast in eastern Japan show that low probabilities but very tall-height tsunami due to the maximum-size and fore-facing large events are evident in the southern part of the area, on the other hand, the Sanriku-Oki-hokubu earthquakes would much contribute to the local hazard in northern part of the area.

In order to show up over-all feature of the probabilistic tsunami hazard around Japan, we now go on the assessment for adjacent seismically active regions, such the Nankai Trough. Meanwhile, it is clear that we have a several point to be improved on our approach technically and that a system for publicizing our products shall be developed.

Keywords: tsunami, probabilistic tsunami hazard assessment, Japan trench