PTHA along Southern Kuril Trench (1) An assessment that seismological parameters of all earthquakes are not specified

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We made a probabilistic tsunami hazard assessment (PTHA) for earthquakes along the southern Kuril Trench between off Tokachi coast, Hokkaido and off Shimushiru Islands in a case where seismological parameters, such as those location, source geometry and magnitude, of all earthquakes are cannot be considered to be previously specified (hereinafter, we call such earthquakes NS (Not Specified) earthquakes).

We regarded all the earthquakes NS earthquakes and constructed "characterized earthquake fault models" (CEFMs) for those. This is a requirement to permit us to assess tsunami hazard probabilistically without seismological knowledge peculiar to the southern Kuril Trench such as source geometry, location, and occurrence history of the large earthquakes there but with a set of primary rules applicable to all of the Japanese subduction zones. We considered that a NS earthquake should be expressed with a square fault model on the analogy of a point source, often used in seismology in the cases where source geometry is unknown.

Total of 3,347 square-shape CEFMs were constructed for earthquakes with magnitudes from Mw 7.0 to 9.4. However, widths (dip direction) of square fault models (or large slip area) with Mw >= 8.5 become wider than width of the seismogenic zone in the southern Kuril Trench subduction zone. For CEFMs with Mw >= 8.5, therefore, we deformed their original square geometries so as to span within the seismogenic zone (Ohshima et al., this JpGU). This deformation implies that such CEFMs are constrained with seismological knowledge of "the seismogenic zone geometry" in the southern Kuril Trench. So we have to mention that in the strict sense, we do not regard CEFMs with Mw >= 8.5 NS earthquakes.

Heterogeneity in slip distribution on earthquake fault affects tsunami generation strongly, hence nearby coastal tsunami height distribution. We expressed heterogeneity in slip distribution by introducing a large slip area on a fault. For events with Mw >= 8.5, diversity of the heterogeneous slip distribution was expressed by a set of different location of a large slip area. For every event with Mw < 8.5, we prepared only a CEFM with a large slip area fixed on the center of the fault. Instead we introduced probabilistic density function, with log-normal distribution, defined in the (occurrence probability, coastal tsunami height) domain to express the diversity of the heterogeneous slip distribution as aleatory uncertainty. Total of 3,347 CEFMs are constructed. To obtain maximum tsunami height at all the coastal points, we solved a non-linear long wave equation (Saito et al., this JpGU).

From the JMA earthquake catalog from 1923 to 2010, annual frequency of Mw >= 7 inter-plate earthquakes along the southern Kuril Trench is estimated 0.362 events per year. By employing that G-R relation with a b-value of 0.9 (Fujiwara et al., 2014, NIED paper), we obtained annual frequency N(Mw) inherent in each of earthquake groups with common magnitudes. By assuming that each of the earthquake groups occurs randomly in time, which implies that earthquake occurrence follows a stationary Poisson process with annual frequency N(Mw), we estimated occurrence probability for each of 3,347 CEFMs to obtain tsunami hazard curves at every evaluation point along all the coasts (Abe et al., this JpGU). Numerous The PTHA thus obtained is not based on any seismological information such as magnitudes and occurrence history of specific large earthquakes along the southern Kuril Trench. So this kind of PTHA is considered robust against possible future changes in evaluation of each of large earthquakes.

Our PTHA suggested that the excess probability that coastal tsunamis become higher than 3 meters in 30 years is estimated over 30 % at most of Pacific coasts, east of the Erimo Pen., Hokkaido. This means that these coasts are expected to experience tsunamis over 3 meters at least every 100 years.

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