A Sensitivity Study for an Evaluation of Input Parameters Effect on a Preliminary Probabilistic Tsunami Hazard Analysis

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1. Introduction

The necessity for study on the tsunami hazard has been emphasized in the Korea Peninsula since the event occurred in Fukushima. The tsunami hazard analysis has been based on the seismic hazard analysis [1]. The seismic hazard analysis has been performed by using the deterministic method and the probabilistic method. To consider the uncertainties in hazard analysis, the probabilistic method has been regarded as attractive approach. The various parameters and their weight are considered by using the logic tree approach in the probabilistic method. The uncertainties of parameters should be suggested by analyzing the sensitivity because the various parameters are used in the hazard analysis.

To apply the probabilistic tsunami hazard analysis, the preliminary study for the Ulchin NPP site had been performed [2]. The information on the fault sources which was published by the Atomic Energy Society of Japan (AESJ)[3] had been used in the preliminary study. The tsunami propagation was simulated by using the TSUNAMI_1.0 which was developed by Japan Nuclear Energy Safety Organization (JNES) [4]. The wave parameters have been estimated from the result of tsunami simulation [5]. In this study, the sensitivity analysis for the fault sources which were selected in the previous studies has been performed.

2. Methods

To consider the uncertainties of the parameter, a number of parameters and their weights were used in the probabilistic method. Fig.1 shows the example of input parameters for the probabilistic tsunami hazard analysis (PTHA). The sensitivity analysis has been performed to present the effect of each parameter. The various factors which were composed with many parameters and their weights were considered in the PTHA. To present the effect of each parameter for the factor, the parameter without weight for the factor was used. It means that the parameter without weight for only one factor was used and the parameters with their weights for the other factors were used. Therefore the hazard analysis should be performed as much as the parameters of the factors. And then the effects of parameters for the factor were shown by comparing with the each hazard for the parameters.

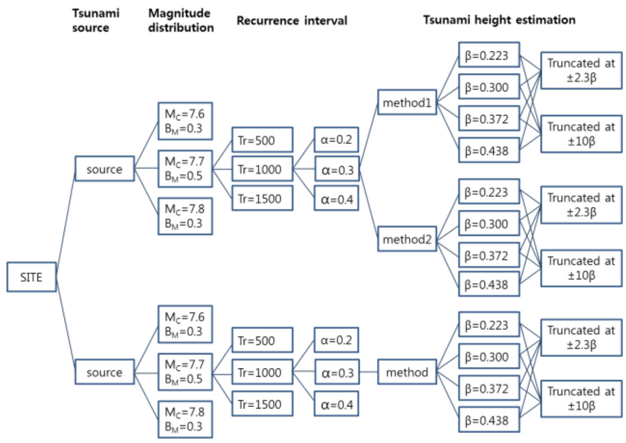

Fig. 1 Example of input parameter for the PTHA

3. Input Parameters

The fault sources in western part of Japan were selected in the fault sources which were published by AESJ. The information about potential maximum magnitude, recurrence interval, and fault orientation for the fault sources had been used. The locations of the fault sources were shown in Fig. 2.

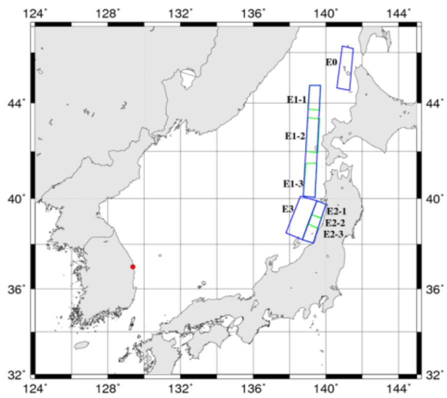

Fig. 2. The location of the fault sources for tsunami hazard analysis and target NPP site

A tsunami source model for the PTHA has been regarded as the composite model which was combined the truncated exponential and characteristic model [6]. Magnitudes are exponentially distributed up to the magnitude m^u . The characteristic earthquake is uniformly distributed in the magnitude range from $m^u - \Delta m_c$ to m^u . For consider these characteristics, the magnitudes of fault sources were applied the range of magnitude. Therefore the tsunami simulations were performed by using the fault parameters which were estimated from the range of magnitude. And a tsunami hazard was calculated by using the wave parameters which was estimated from the tsunami simulations. [2].

The wave parameters for the PTHA had been estimated from the previous study [5]. The beta which is regarded as the deviation parameter between a simulated result and real record of tsunami should be considered, because the wave parameters had been estimated from the simulation. The distribution for wave height has been based on the lognormal distribution. So the truncated value for lognormal distribution should be considered too. The parameters for the E3 fault sources which were consist of the potential maximum magnitude M_w , the recurrence interval ν , the dip angle, the beta, and the truncated values were summarized in Table I.

Table I: The information for the E3 fault source

M_W	ν (yr)	Dip (°)	Beta (β)	truncate
7.8±0.2	500	30	1.25	2.3 β
7.7±0.1	1000	60	1.35	10.0 β
7.8±0.1			1.45	
7.9±0.1			1.55	

4. Sensitivity Analysis Result

To analyze the sensitivity, the E3 fault source has been selected by the previous study [2] which it has been regarded as the most important source for hazard analysis. The sensitivity analysis for the potential magnitude, the recurrence interval, the dip angle, the beta, and the truncated value had been performed.

Fig. 5 shows the effect for the recurrence interval. The 2 recurrence intervals were considered (RI1: 500 yr, RI2: 1000yr). There is the remarkable difference in the level of annual exceedance probability according to the recurrence interval. It means that the level of annual exceedance probability has been depended on the recurrence interval. The sensitivity analysis result for the potential magnitude and their range were presented in Fig. 4. The 4 potential magnitudes and their ranges were used in this study (MR1: 7.8±0.2, MR2: 7.7±0.1, MR1: 7.8±0.1, MR1: 7.9±0.1). The result has been regarded that the wave heights were affected by the potential maximum magnitude. There is a dependency of wave parameters for the maximum magnitude. Fig. 5 shows the effect for the beta (BETA1: 1.25, BETA2: 1.35, BETA3: 1.45, BETA4: 1.55). The notable difference in the hazard has been presented by the beta. The result was considered that the wave heights were affected by the beta. The effect and the reason were similar to those in the potential magnitude. The sensitivity analysis result for the dip angle (DIP1: 30°, DIP2: 60°) and the truncated value (LNDT1: 2.3 β , LNDT2: 10.0 β) for the lognormal distribution were arranged in Fig. 6 and Fig. 7. There are relatively inappreciable differences in the parameters.

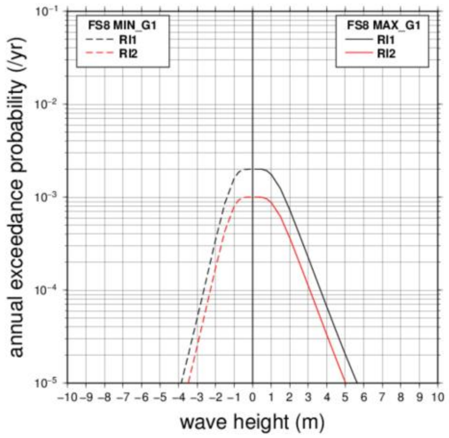

Fig. 3. Sensitivity analysis for the mean recurrence interval

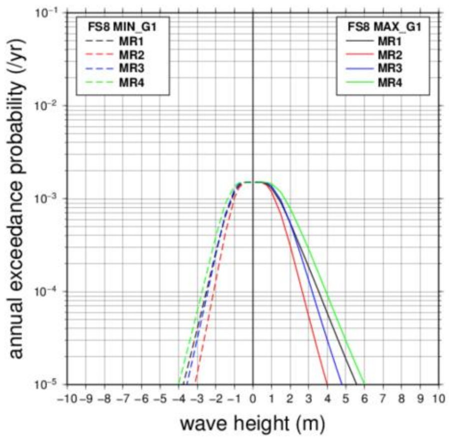

Fig. 4. Sensitivity analysis for the potential magnitude

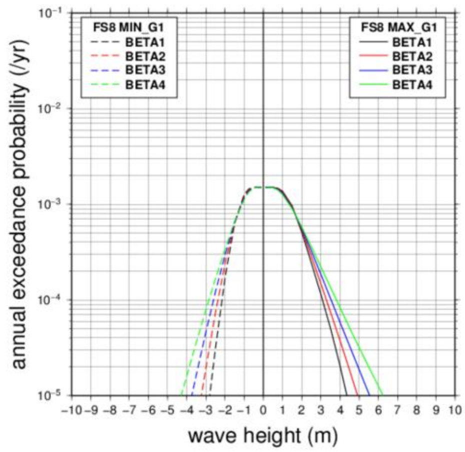

Fig. 5. Sensitivity analysis for the beta

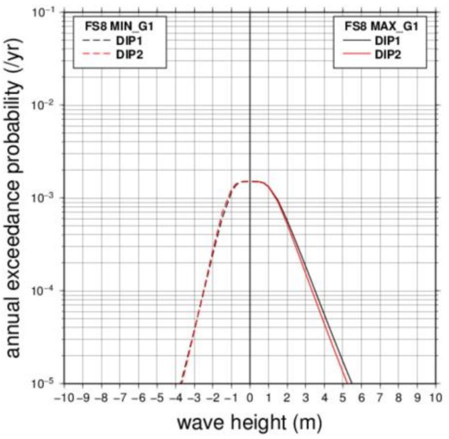

Fig. 6. Sensitivity analysis for the dip angle

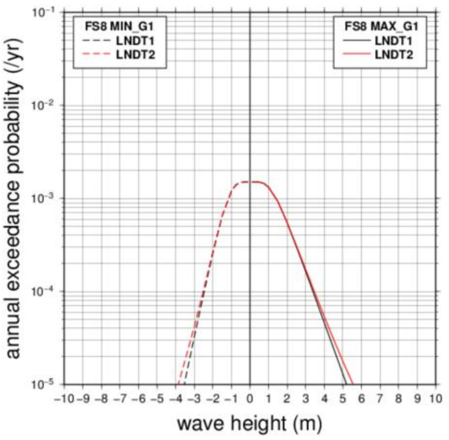

Fig. 7. Sensitivity analysis for the truncated value

5. Summary

To analyze the effect of the parameters, the sensitivity analysis for the E3 fault source which was published by AESJ was performed. The effect of the recurrence interval, the potential maximum magnitude, and the beta were suggested by the sensitivity analysis results. Level of annual exceedance probability has been affected by the recurrence interval. Wave heights have been influenced by the potential maximum magnitude and the beta. In the future, the sensitivity analysis for the all fault sources in the western part of Japan which were published AESJ would be performed.

Acknowledgment

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