Effect of the Logic Tree Types on the Seismic Hazards in the PSHA

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1. Introduction

The logic tree is generally used to apply the weights of input parameters in the probabilistic seismic hazard analysis (PSHA) which was suggested to consider many input parameters. The PSHA have been performed by using the logic tree of two types. The analysis which was performed using the each logic tree type has both advantage and weakness. This study performed the PSHA by using logic trees of two types and calculates the mean hazard and percentile by using three percentile calculation methods [1].

2. Logic Tree and Seismic Hazard

2.1 Logic Tree

The expected events and their probability on the nuclear power plant (NPP) site could be calculated by using the logic tree. The typical type of logic tree is shown in Fig.1 [2]. Fig.1 illustrated that the combined seismic sources by input parameters were horizontally arranged in seismotectonic model which composed seismic sources. The horizontal arrangement of seismic sources implies that the each expected events in all seismic sources simultaneously occur on the site. A number of sequences for logic tree which was horizontally arranged by seismic sources increase as product of sequences of seismic source and sequences of other seismic source. The PSHA which was performed by using logic tree of this typical type is difficult and requires a lot of times because of too many sequences. Fig.2 shows the other type of logic tree which was used to perform the more easily and simpler PSHA. The seismic sources were vertically arranged in this type of logic tree. The vertical arrangement of seismic sources implies that the each expected events in seismic sources separately occur on the site. A number of sequences for logic tree which was vertically arranged by seismic sources increase as summation of sequences of all seismic source. A number of sequences for logic tree of this vertical type significantly decrease than logic tree of horizontal type. But the performed PSHA result by using logic tree of vertical type suggests very small seismic hazard on the source which not included a site. This very small seismic hazard affected on the percentile of seismic hazard.

The efficiency and accuracy of the PSHA were depending on the type of logic tree. Therefore this study performed the PSHA by using each logic tree type.

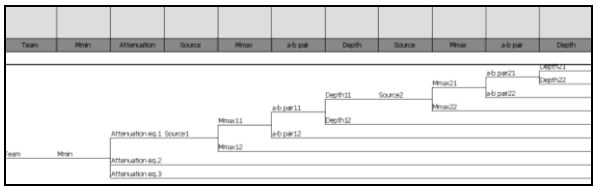

Fig. 1 The Logic Tree of Horizontal Type

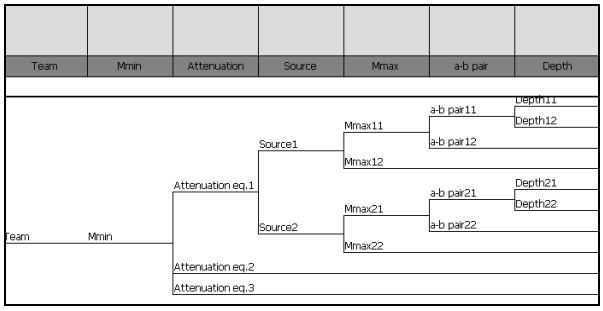

Fig. 2 The Logic Tree of Vertical Type

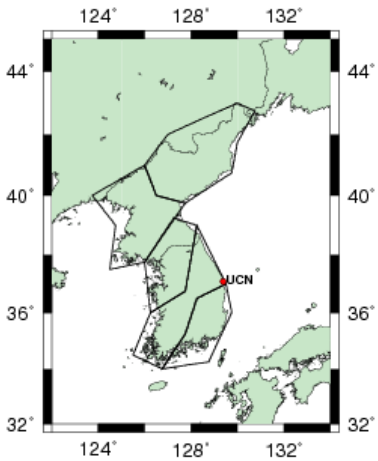

Fig. 3 Seismic Source Map

2.2 Seismic Hazard

This study performed PSHA by using the logic tree of horizontal type and vertical type on the Shinulchin NPP site. Fig. 3 shows the study site and source geometry.

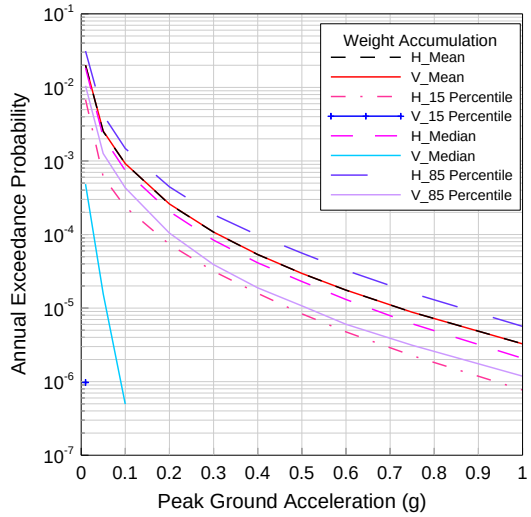

Fig. 4 The Comparsion of Mean Hazard and Percentile Curves on the Weight Accumulation Method

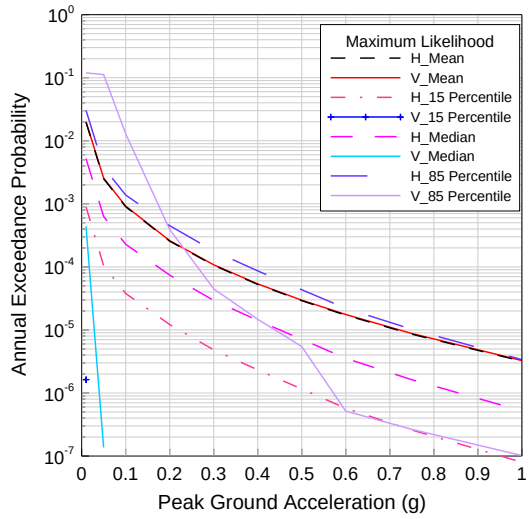

Fig. 5 The Comparsion of Mean Hazard and Percentile Curves on the Maximum Likelihood Method

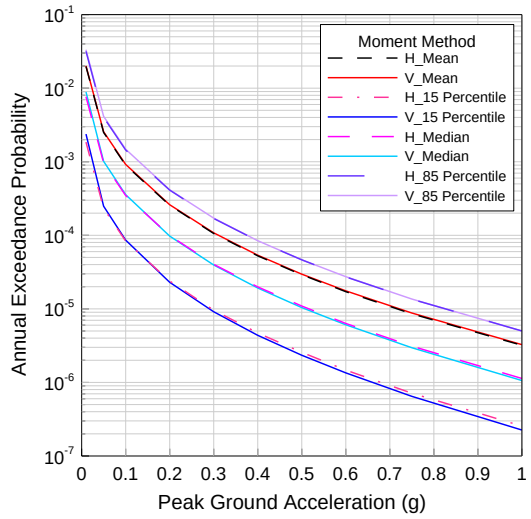

Fig. 6 The Comparsion of Mean Hazard and Percentile Curves on the Moment Method

Fig. 4 ~ Fig. 6 shows calculated the mean hazard and percentile curves from the performed PSHA results by using the logic tree of different type. The difference of the mean hazards on the logic tree types and percentile calculation methods is very small as the logarithmic standard deviation of about 0.01. The differences of the calculated percentiles according to three methods (weight accumulation method, Maximum likelihood method, and moment method) are also small as the logarithmic standard deviation of about 0.02-0.93 from the hazards which were calculated by using the logic tree of horizontal type. But there are more lager differences as the logarithmic standard deviation of about 0.64-9.06 from the hazards which were calculated by using the logic tree of vertical type. In such that the percentiles were calculated by maximum likelihood method, the 85 percentile curve showed the abnormality type. Although the hazards were computed by using the logic tree of different type, the percentiles which were calculated by using the moment method were almost same as the logarithmic standard deviation of about 0.00-0.07.

3. Conclusions

This study had compared mean hazard and percentile on the hazards which were calculated by using two logic tree types and three percentile calculation methods. The results showed almost same mean hazard and very different percentiles on the logic tree types and the percentile calculation methods. There are the dependency on the logic tree type of percentiles which were calculated by using the weight accumulation method and the maximum likelihood method. And there is the independency on the logic tree type of the calculated percentile by the moment method. Therefore this study suggested that the mean hazard and percentiles on the hazard which were computed by using the logic tree of vertical type would be calculated by the moment method in such that the logic tree of horizontal type has too many event sequences.

ACKNOWLEDGEMENT

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