A study on tsunami vulnerability assessment in South Korea

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ABSTRACT

This study aimed to estimate tsunami vulnerability in South Korea where power plants, seaports, and large-scale urban area have constantly developed. For the purpose, we estimated tsunami behavior using the FUNWAVE model and identified vulnerable factors from modified 3-round Delphi methods. The priorities order of the alternatives were ranked by assessments results of MCDM methods as TOPSIS and VIKOR. In addition, the tsunami vulnerability index was developed by combining the results. The approach can be provided to quantifying vulnerability to manage tsunami vulnerability in South Korea.

KEY WORDS: Tsunami; FUNWAVE; Nankai Trough; Vulnerability assessment.

INTRODUCTION

In March 2011, the earthquake of magnitude 9.0 that occurred and it generated a huge tsunami. According Japanese National Police Agency, the number of casualties is about 25,000. The economic damage was estimated US$235 billion, which the World Bank presented it the costliest natural disaster in world history. The tsunami propagated to the Korea coast. After earthquake, the generated waves would reach Masan City (Korea) in approximation 6 hour with 0.1 to 0.2 meter wave heights. The two earthquake scenarios discussed, the first was March 2011 Tohoku earthquake and second was hypothetical Nankai trough earthquake. The Nankai trough is a submarine trench located south of Japan’s island of Honshu, extending approximately 900km offshore. The potential impact on the coast by the Nankai trough earthquake has been reviewed in 2003 by the Japanese government. However, the magnitude-9.0 earthquake that occurred in March 2011, the Japanese government has decided to re-evaluation the event and extensive studies revealed that the occurrence of a magnitude-9.0 earthquake in the Nankai Trough. In this revealed result, the tsunami waves have been estimated approximately 50% bigger than previous results. Even more Nankai trough close to the South Korea compared to the epicenter of the Tohoku Earthquake. Thus, the Nankai trough was carefully examined in this paper. As you many know tsunami is one of the most destructive natural disasters that take very strenuous, costly and time consuming to recovery, Korea is not free from tsunami, with Nankai trough. And therefore it is just imperative for Korea to pursue a policy against tsunami. This study can provide useful approach for tsunami vulnerability assessment.

METHODOLOGY

FUNWAVE

Boussinesq models have been widely used to model ocean wave processes (Wei et al., 1995, Nwogu, 1993). One major advantage of using these equations over the NSW equations is that they are valid in deeper water than the NSW equations. Numerical models of these equations have been shown to be able to accurately predict wave evolution, decay in wave heights due to breaking induced dissipation, wave run-up, wave induced currents and other processes. Since these equations can efficiently and accurately model wave propagation, FUNWAVE (Kirby et al., 1998) which is a finite difference model is chosen for the Boussinesq modeling part of this research.

TOPSIS

The TOPSIS technique was developed to solve MCDM problems in which there is no articulation of preference information (Hwang and Yoon, 1981). The technique is based on the concept that the ideal alternative has the best level for all attributes, whereas the negative ideal is the alternative with all of the worst attribute values. A TOPSIS solution is defined as the alternative that is simultaneously farthest from the negative ideal and closest to the ideal alternative (Chu, 2002, Jun et al., 2011, Lee et al, 2013).