Typhoon Risk Analysis Model Based on Poisson-P-III Compound Extreme Value Distribution

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ABSTRACT

A basic paradigm of typhoon risk analysis was proposed, which involves the probability distribution of disaster intensity and the disaster loss rate curve. The expected risk value was calculated by integrating the product of these two terms. The innovation lies in the frequency of disasters in one year was considered, so the Poisson-P-III compound extreme value distribution was applied to the model. Then the coastal areas in western Guangdong were taken as the research area by calculating its average loss rate of several indicators related to economy, population, crops, and houses. The results showed that the model is reliable and has a certain reference value for emergency management.

KEY WORDS: typhoon; annual risk; expected value; extreme wind speed; compound extreme value distribution.

INTRODUCTION

Typhoons are accompanied by strong winds, rainstorms, and huge waves, which usually cause damages in the form of the disaster chain. Against the background of global warming and rising sea-levels, the typhoon has become the most severe meteorological disaster that threatens the survival and the development of human beings. China is located on the west coast of the Pacific Ocean, which is the hardest-hit area of typhoon disasters. There are about eight typhoons attack the southeast coastal areas of China every year, causing more than 20 billion Yuan of economic losses and approximately 400 deaths. In recent years, the risk of the typhoon disaster has risen, and the loss of life and property has increased year by year with the acceleration of urbanization in coastal areas. So it is necessary to make a comprehensive assessment of typhoon risk to formulate effective measures for reducing the vulnerability of bearing-bodies and improving their defensive capabilities.

Many scholars have carried out some relevant researches: Guo (2017) made use of information diffusion technology to calculate the expected value of the annual economic loss in typhoon disasters of Guangdong province, believing that the method could improve the utilization efficiency of small samples and get reliable analysis results. Gu (2018) established the risk analysis model of typhoons about Ningbo by using AHP and fuzzy algorithm and thought that the loss of economy and aquaculture caused by typhoons making landfall in Zhejiang province are increasing in recent years. Zhou (2013) constructed a comprehensive risk assessment index system by integrating the risk, the vulnerability, the exposure, and the prevention capacity and the reduction capacity of the typhoon, making a risk analysis in Zhejiang province and conducting a regional classification of disaster levels. Some foreign scholars have also done some relevant researches: Kim (2018) built a loss prediction model by analyzing the characteristics of typhoon intensity and path to develop response strategies of different typhoon risks. In studying the risk of the hurricane disaster, Jain (2005) pointed out that the indoor property, the type, and the vulnerability of buildings are in dynamic change, and then he established a risk assessment model that changes with time. Summarizing previous research, most scholars focus on the prediction of the economic loss, and pay more attention to the intensity of disasters but ignore the frequency. Therefore, this study will analyze the importance of considering the number of disasters in typhoon risk analysis and use a variety of indicators to conduct a comprehensive risk assessment of the study area.

In this study, a risk analysis model coupling the probability density function of the annual extreme wind speed and the typhoon loss rate curve is built, and the compound extreme value distribution is applied to it. Then the coastal areas of western Guangdong are taken as the study area, and the annual expected values of the disaster loss related to economy, population, crops, and houses are calculated, in the hope that the analysis results can provide a reference for the risk control and the emergency management of typhoon disaster in this area.

Formal Paradigm of Typhoon Risk Analysis