# Vulnerability Analysis of High-speed Railway System under Typhoon Disasters in China

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## Abstract

The high-speed railway system is consisted of high-speed railway and high-speed trains. It has the advantages of fast, safe, cost-effectiveness and large passenger volume. The high-speed railway system shortens travel time between regions and affects accessibility across regions. How to evaluate the impact of high-speed railway system on accessibility in various regions is a key scientific issue for improving and planning existing high-speed railway system. In addition, China is seriously affected by the typhoon, and the typhoon poses risks to the operation of the high-speed railway system. The typhoon Mangosteen that landed in China in September 2018 has caused more than 15% of high-speed trains to be shut down,which seriously affected the service level of the high-speed railway system. How to analyze the vulnerability of the high-speed railway system under typhoon disasters is a key issue to improve the performance of the high-speed railway system to deal with typhoon disasters. In view of the above scientific problems, this paper studies the accessibility of high-speed railway by combining timetable and population distribution data. The historical typhoon disaster and its train outage data are used to study the fragility of high-speed railway system in the case of typhoon disasters.

The main research contents of this paper are as follows: Firstly, establish the fragility model of high-speed railway system's components under typhoon scenarios. Then proposes the accessiblity calculation method for high-speed railway system which considering population, departure frequency and travel time. Then combines with the vulnerability assessment method under localized attack events, analyzes the vulnerability of high-speed railway system during typhoon Mangosteen; finally, bases on typhoon historical data, analyzes the vulnerability of high-speed railway system under typhoon disasters. The research results of Chinese high-speed railway system show that: (1) high-speed railway stations with high accessibility are mainly distributed in the Beijing-Tianjin-Wing, Yangtze River Delta and Pearl River Delta economic circles, and the Beijing-Tianjin-Wing region drives the accessibility of Zhengzhou Shijiazhuang which is along the Beijing-Tianjin-Wing High-speed rail. The Urumqi Lanzhou route and the Ordos Hohhot line need to be improved to increase the accessibility of high-speed railway stations along the route. (2) The vulnerable area of the high-speed railway system components caused by Mangosteen on September 16 is larger, and the overall vulnerability of the high-speed railway system on September 16 is 6.8 times that of September 17. (3) The high-speed rail system components in Taiwan and Hainan

are seriously affected by the typhoon. Secondly, the high-speed railway system components along the Zhanjiang West Zhuhai and Xiamen Fuzhou are vulnerable to typhoon. High-speed railway stations in coastal areas are most vulnerable under typhoon disasters. In the process of the high-speed railway spreading to the central region to Changsha, Wuhan, Nanchang, Guiyang, Chongqing and other regions, the vulnerability of high-speed railway stations under typhoon scenarios is gradually decreased.
Key words: High-speed railway system; Vulnerability; Accessibility; Typhoon disasters