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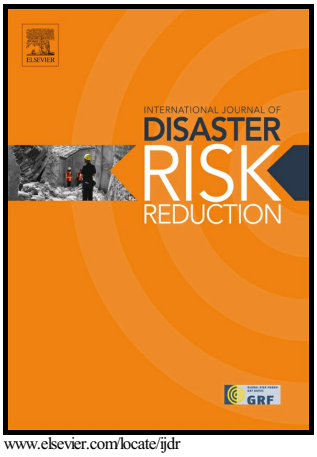

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Vulnerability Assessment of urban road network from urban flood

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Abstract

Flood and flood-related problems have become more rampant all over the world leading to loss of life, infrastructure damage, and epidemics every year. There are evidences in recent years where heavy precipitation events have resulted in severe detrimental floods in India. A number of major cities in India have reported a series of devastating floods in the recent decade. The immediate impact of floods specifically in urban areas is on the transport system. Most of the studies on transport vulnerability consider topographic properties along with supply and demand side of transport system to access the disruption; but less attention is given to the potential impacts of weather extremes on the performance of transportation network. In response to that, this study aims to provide a framework to assess the vulnerability of urban road network due to floods. An integrated framework linking meteorological information, land use functions, and hydrodynamic model with safety speed function is used to relate flood depth to reduction in speed in order to determine road network vulnerability. Two rainfall events with 1-in-10 year and 1-in-100 year return period were simulated for inundation mapping over road network and spatial vulnerability of road network was assessed. A critical map and index is developed to identify affected road length vulnerable to flood. It has been observed that more than 40% of road length across the network becomes immovable for 1-in-100 year rainfall event. Also, there is a significant decrease in average maximum speed in each road category corresponding to its normal.

Key words: Road Network Vulnerability, Urban Flood, MIKE 21, Gumbel Distribution, Flood Mapping

1. Introduction

Flood is directly attributed to heavy precipitation; but climate change, rapid urbanization and unplanned urban development act like a catalyst as they alter the hydrological response of the catchment. Climate change has a direct implication on precipitation patterns globally. An increase in frequency of heavy precipitation events is likely to intensify in all emission scenarios (Sen Roy 2009; Trenberth 2011; IPCC 2014). Several studies on Indian region has also reinforced a significant rise in the frequency and duration of monsoon breaks during recent decades (Kumar *et al*. 2009; Turner and Hannachi 2010), with increase in the frequency of extreme rainfall events in certain parts of the country (Goswami *et al*. 2006). Thus, higher intensities of rainfall are the likely hydrological future for India.