Study on waterlogging control in highly built-up urban areas based on MIKE coupling model.

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Objectives

Due to the global climate change in recent years, the frequent occurrence of extreme rainfall events has aggravated urban waterlogging disasters. For highly built-up urban areas, improving the effect of waterlogging control under the conditions of limited land space, outdated drainage system and low infrastructure standards are urgently needed. In order to further understand the basic law of urban flood and waterlogging in highly built-up urban areas, the Xinji River area in Dongguan city was selected as the study area in this paper.

Methods

An urban waterlogging coupling model integrated with MIKE URBAN, MIKE 11 and MIKE 21 was developed on the basis of MIKE FLOOD platform. The research analyzed the drainage capacity of the pipeline and waterlogging characteristics in 50a rainstorm scenarios, and evaluated the treatment effect of different waterlogging control measures.

Results

The results showed that the drainage capacity in the study area was lower wholly. The proportion of pipes with drainage capacity less than 2a was 54.65%, which were mostly distributed in the middle and south and could not meet the drainage standard of 3~5a in important areas. Waterlogging was mainly distributed in high building density and low-lying areas, and the water depth was more than 1.3 m. River jacking and inadequate drainage capacity of the pipeline in the waterlogging area was the main constraint. Meanwhile, the inundation area was closely related to the underlying characteristics. Three different measures were used in waterlogging control, including river regulation, river regulation combined with low impact development, river regulation combined with drainage system renovation. These measures could decrease the inundated area of water depth that greater than 0.8 m by about 19%, 20% and 58% respectively.

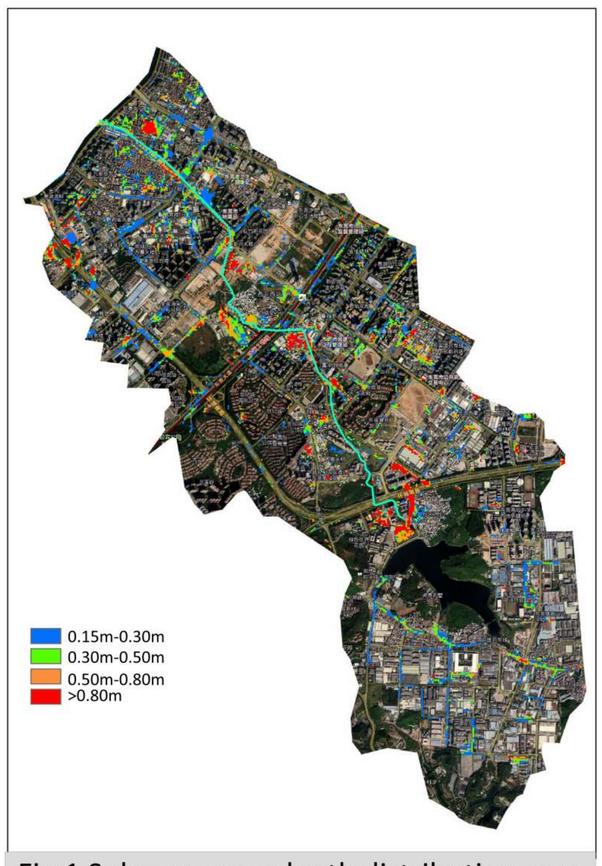

Fig.1 Submergence depth distribution map in the study area

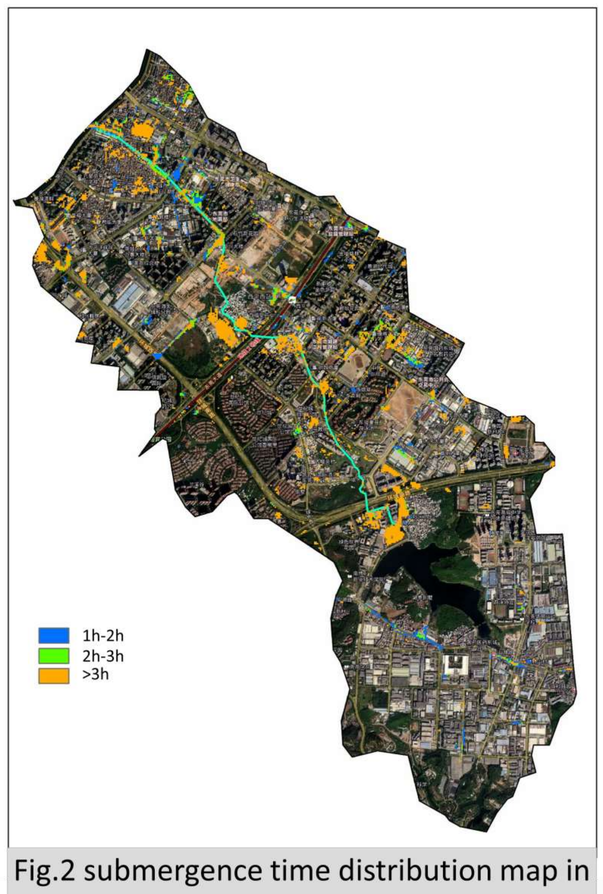

Fig.2 submergence time distribution map in the study area

Conclusions

The results indicated that improving drainage capacity of the pipeline are effective and necessary on reducing the risk of waterlogging under high rainfall intensity conditions, while the low impact development has limited control effect when dealing with urban waterlogging under 50a rainstorm. This study can provide theoretical support and a basic idea for waterlogging prevention in highly builtup urban areas.

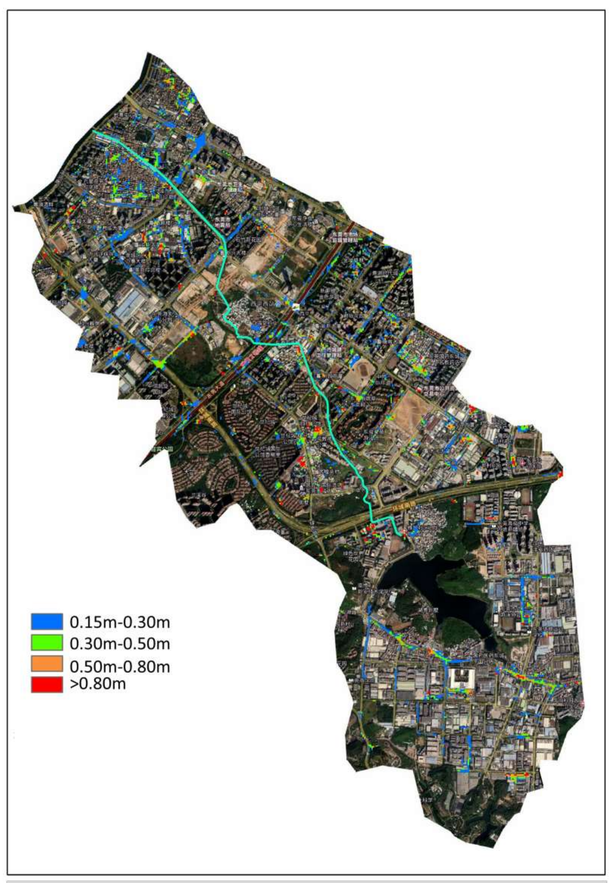

Fig.3 Submergence depth distribution map in the study area after the implementation of the scheme

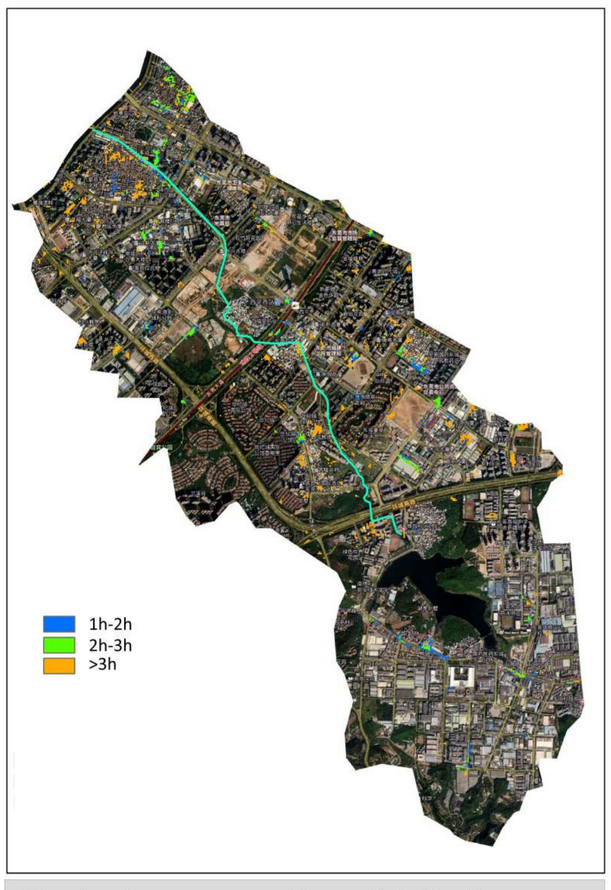

Fig.4 submergence time distribution map in the study area after the implementation of the scheme