FLOOD DISASTER AND SAFE EVACUATION IN DRAINAGE AREA WITH SMALL RIVERS

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INTRODUCTION

The frequency of fluvial floods has been lower than before due to flood control, but the frequency of pluvial floods becomes higher in drainage area with small rivers. To mitigate damages of such floods, it is important to strengthen not only the structural measures but also nonstructural measures. In this paper, the difficulty of evacuation and the time to start evacuation are discussed when pluvial and fluvial flooding occur simultaneously.

1. SIMULATION MODEL

Fig.1 shows the study area. In this area, pluvial floods caused by flooding of small rivers have frequently occurred. Flood in study area is calculated using InfoWorksICM. **Fig.2** shows the structure of calculation model.

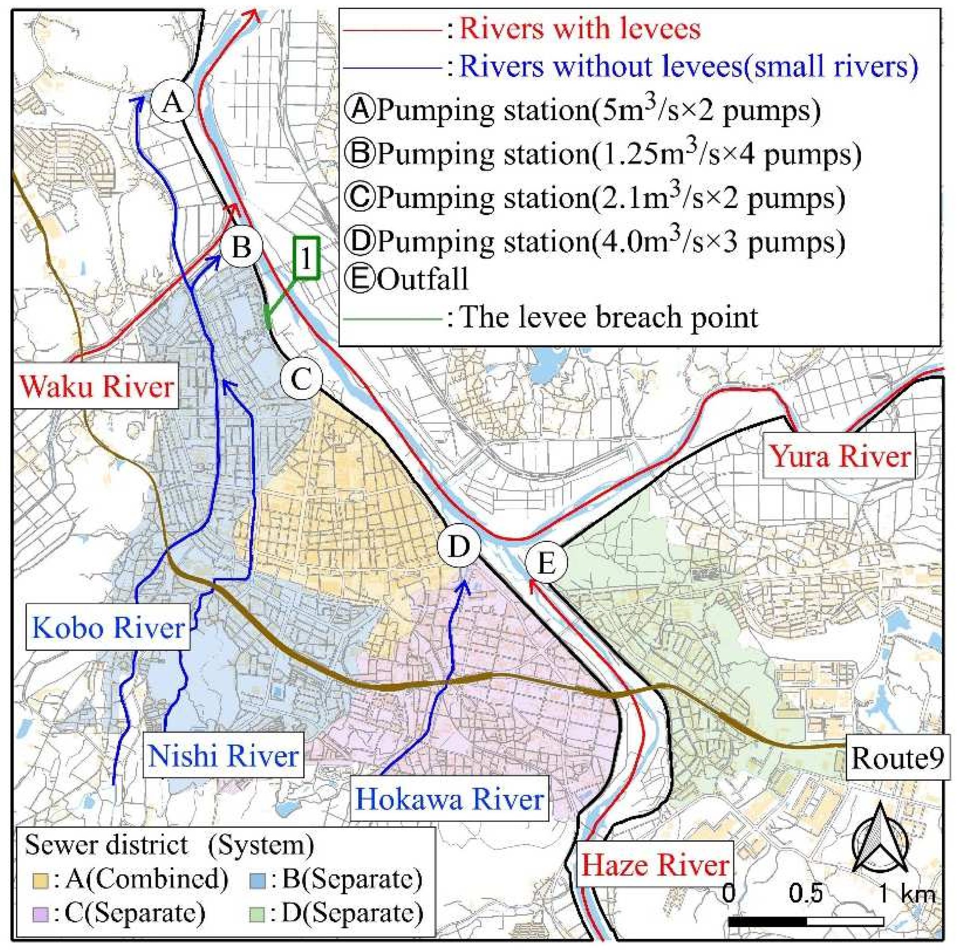

Fig.1 Study area(Fukuchiyama City, Kyoto Prefecture, Japan)

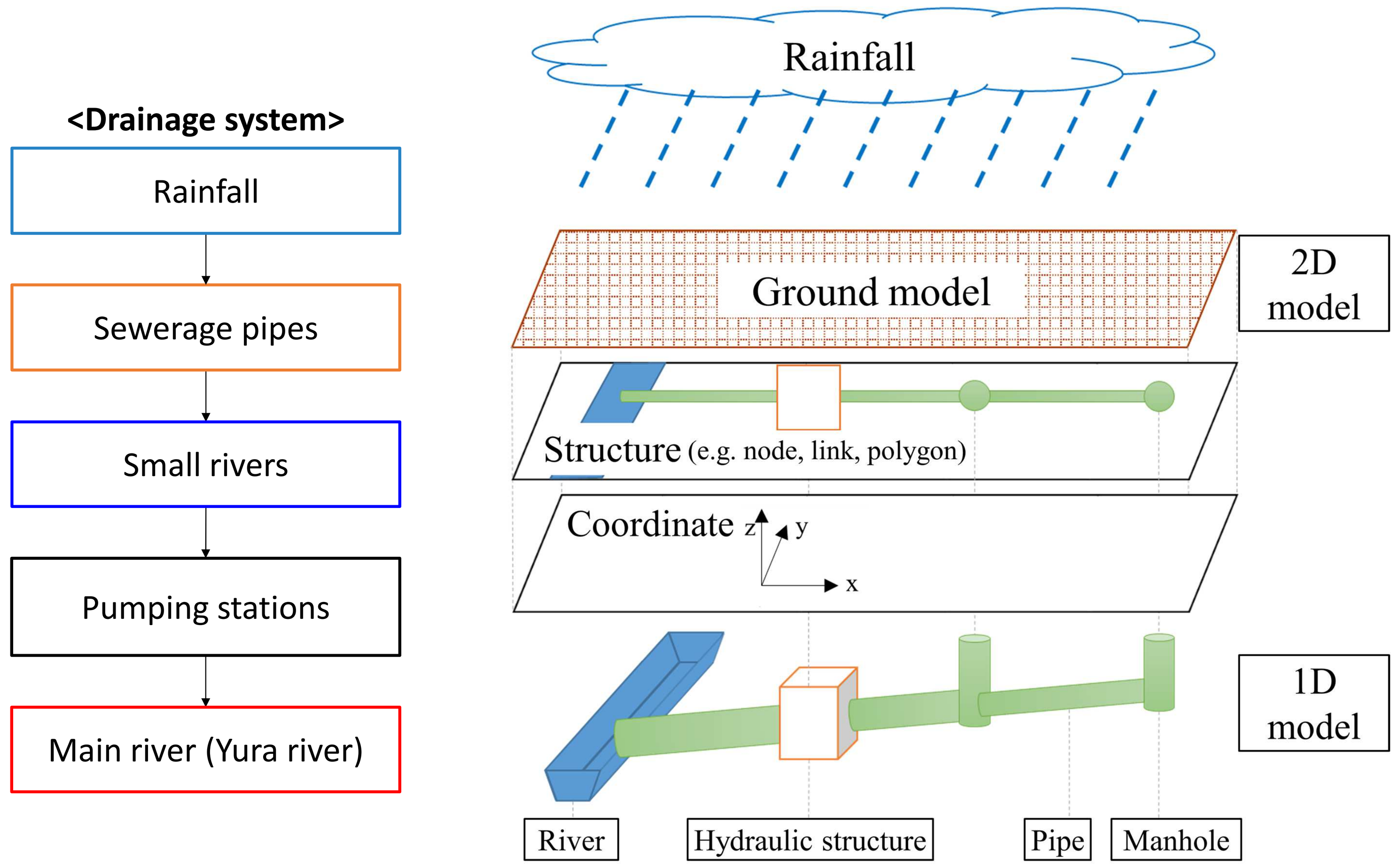

Fig.2 Calculation model structure of InfoWorksICM

Fig.3 shows the results of the calculation of pluvial flooding in 2014. Verification of the model and determination of coefficients were done by using the data of the pluvial flooding that occurred in 2014. The accuracy of the inspection range compared with actually depth is MAE=0.21(m), RMSE=0.28(m), and R=0.55.

The flood discharge was calculated by using the River Planning Simulator Runoff Analysis System of the Japan Institute of Country-ology and Engineering. Yura River basin was divided with reference to Takasao et al. (1988). The coefficient was calibrated using rainfall data at the time of Typhoon 2013. In this study, the extended rainfall of Typhoon 18, 2013, of which total rainfall is 494mm for two days, are used as the extreme condition. The conveyance discharge at Fukuchiyama is 6,500 m^3/s. **Fig.4** shows the extreme rainfall hyetograph, and the conveyance discharge hydrograph.

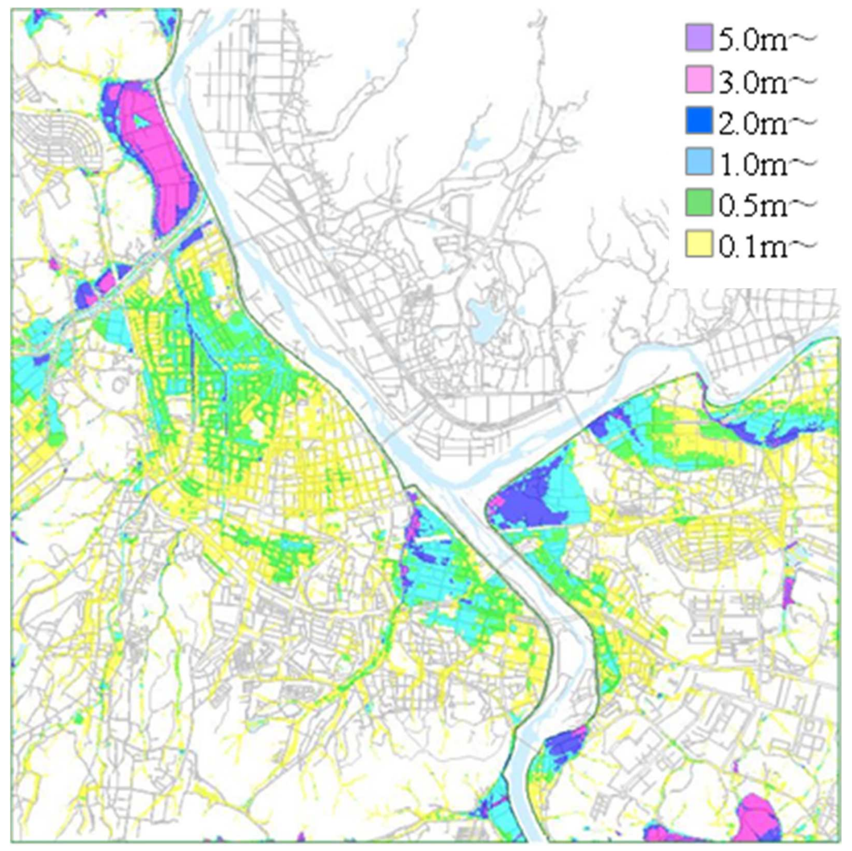

Fig.3 Results of the calculation of pluvial flood in 2014

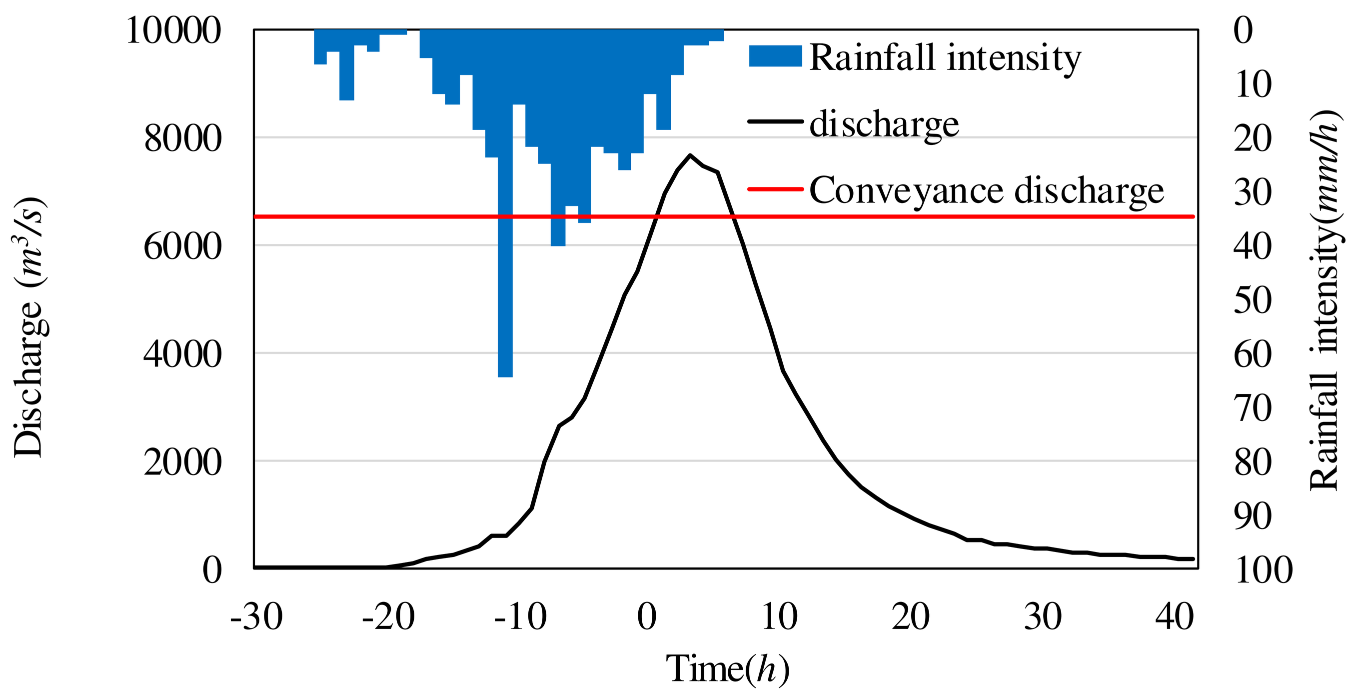

Fig.4 The extreme rainfall hyetograph and hydrograph

2. FLOOD SIMULATION

Fig.5 shows the results of the flood analysis. In this paper, the results for levee break point 1 are shown. t=0(h) is just before the fluvial flood occurs. The result at t=0(h) in **Fig.5** (a) indicates that pluvial flooding occurred before fluvial flooding started. Residents in flooded areas need to evacuate early because floodwaters can reach the second floor.

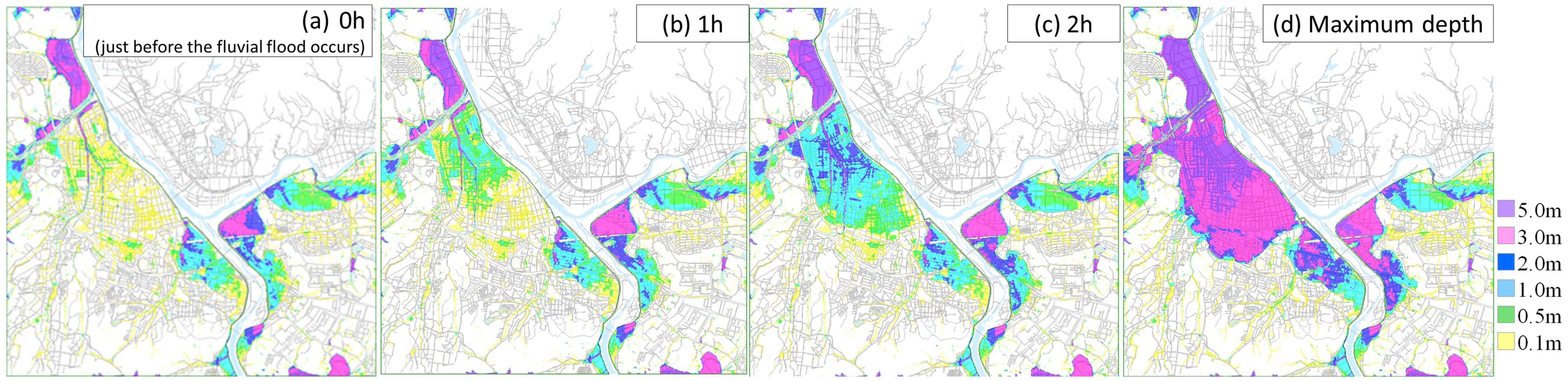

Fig.5 The results of the flood analysis

3. SAFE EVACUATION

The time when the specific force per unit width becomes larger than 0.080(m^3/m) is defined as the evacuation difficulty time (Asai et al.(2010)). The evacuation start time for each community association area was revealed using the shortest route search tool of GIS.

One-third of the people who need evacuation will have the difficulty immediately after the peak of rainfall (**Fig.6**). Pluvial flood has already occurred just before fluvial flood occurs, and about half of those who need to evacuate are already having the difficulty. Also the road shown in **Fig.7**[a] is difficult to evacuate before fluvial flooding occurs, even though most of the inundation depth less than 0.5m as shown in **Fig.5**(a).

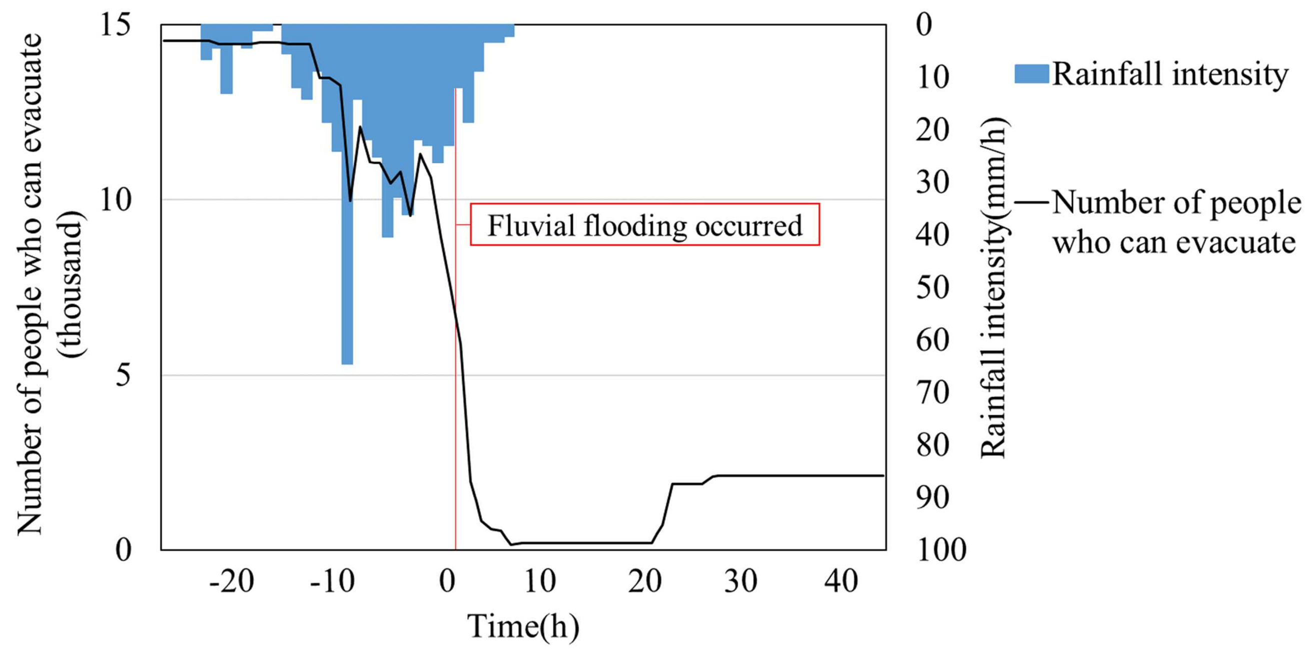

Fig.6 Number of people who can evacuate at each time

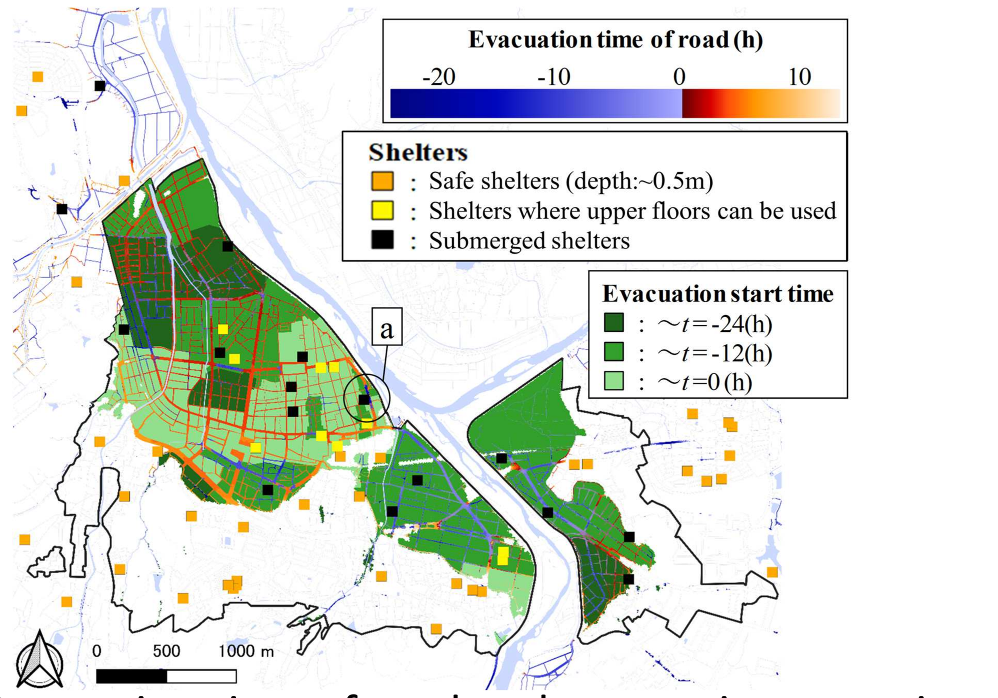

Fig.7 Evacuation time of road and evacuation start time

CONCLUSIONS

In this study, safe evacuation was investigated by using inundation analysis results during pluvial and fluvial floods. The impact of pluvial flooding must be taken seriously because pluvial flooding before fluvial flood occurred were serious.

REFERENCES

- Takasao, T., Takara, K., Mitani, Y., and Fueta, T. (1988) Real-time calibration of rainfall measured by a radar for flood runoff forecasting, DPRI Annuals, Disaster Prevention Research Institute, Kyoto University, No.31 B-2, pp. 1-14. (in Japanese)
- Asai et al. (2010): SAFETY ANALYSIS OF EVACUATION ROUTES CONSIDERING ELDERLY PERSONS DURING UNDERGROUND FLOODING, Journal of Hydroscience and Hydraulic Engineering, Vol.28, No.2 November, 15-21.

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