Flood simulation of the 2021 Thailand flood in the upstream area of Chi River basin
Multi-resolution flood modeling for a specific area in Chaiyaphum City, Chaiyaphum Province in Thailand

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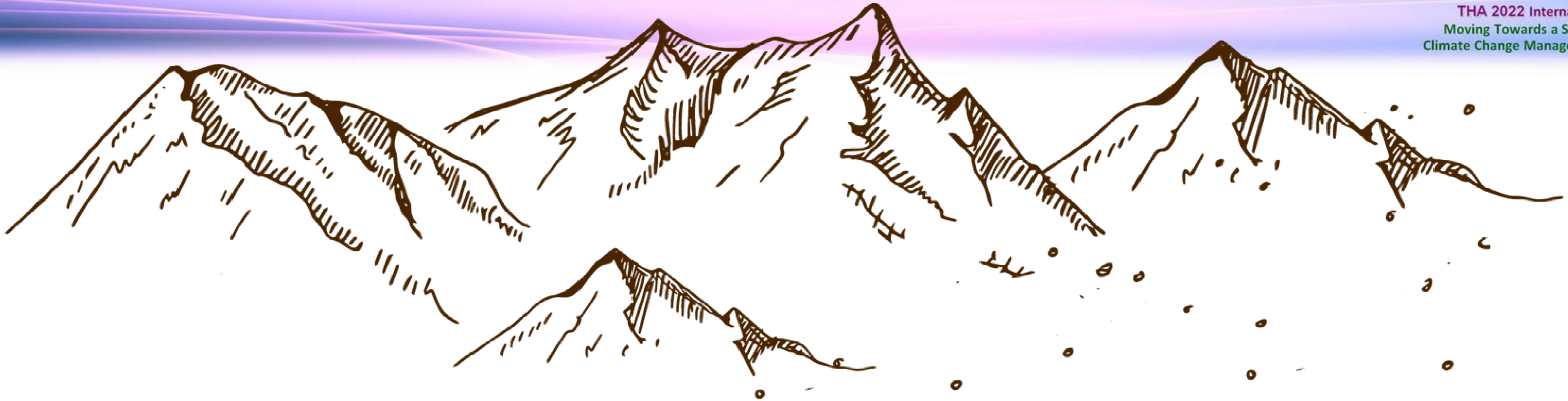


1 INTRODUCTION

2 OBJECTIVE

3 METHODOLOGY

4 Flood model results

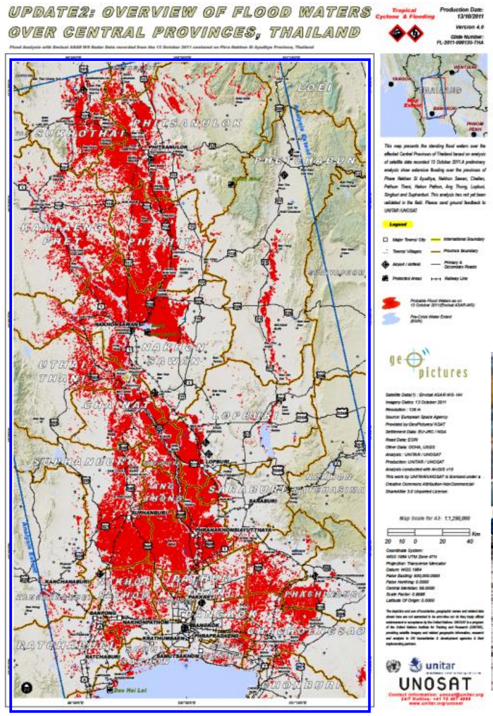
5 Flood hazard map

6 Building hazard analysis

7 Conclusion

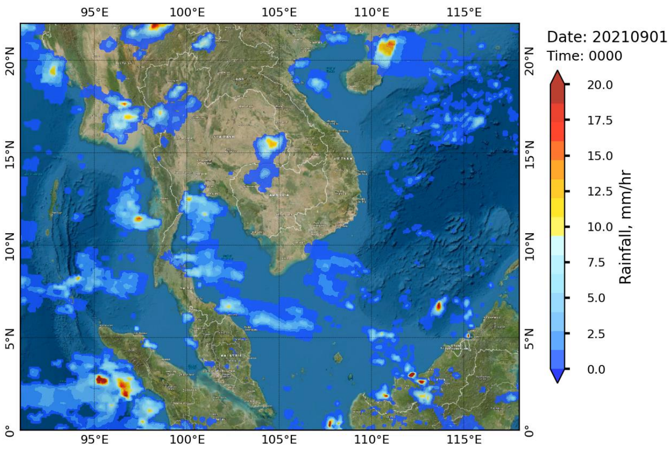
1. Introduction

2011 Flood in Thailand



Date	25 July 2011 – 16 Jan 2012
Location	65 of 77 provinces
Deaths	815
damage	50 billion US

2021 Flood in Thailand, Chaiyaphum province



2. Objective

To understand the flood behavior that is important point for flood **mitigation and protection** in future.

Floods mitigation

At first:
Flood modeling

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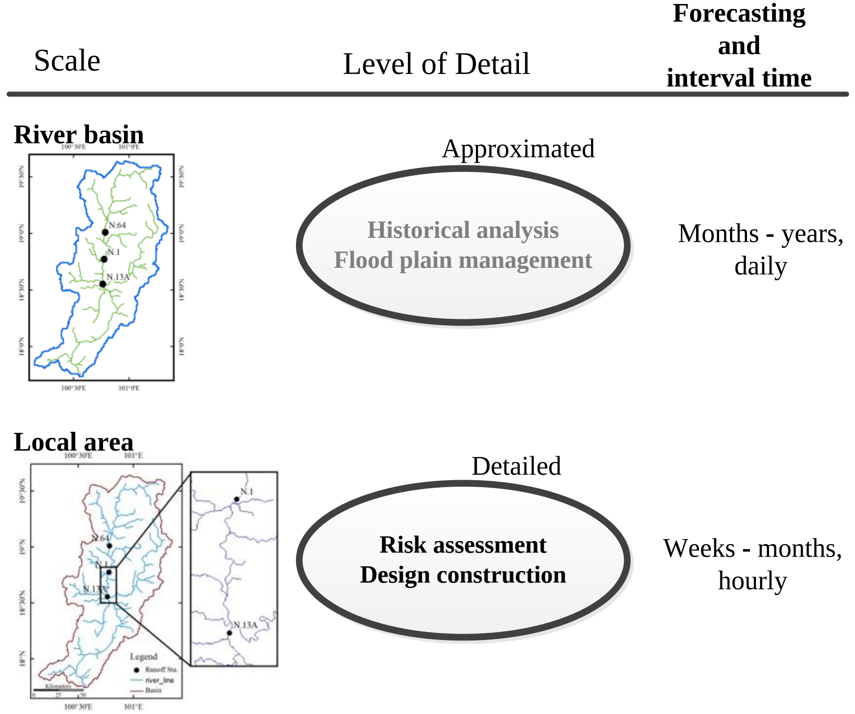
Floods magnitude
(Space, Time & Volume)

If it can understand deep to the community scale that might be get more detail of the flood results.



This study aims to simulate the flood in the upstream area of the Chi River basin with two-dimensional shallow water equations on the geographic coordinate system. The model is combined into 2 regions, large region (basin-scale) and small region (specific area), with the nesting grid method.

3. Methodology (Study area)

The simulation results presented an inundation map for large-scale riverine flooding (Chi-Mun river basin) and specific area in Chiyaphum City.

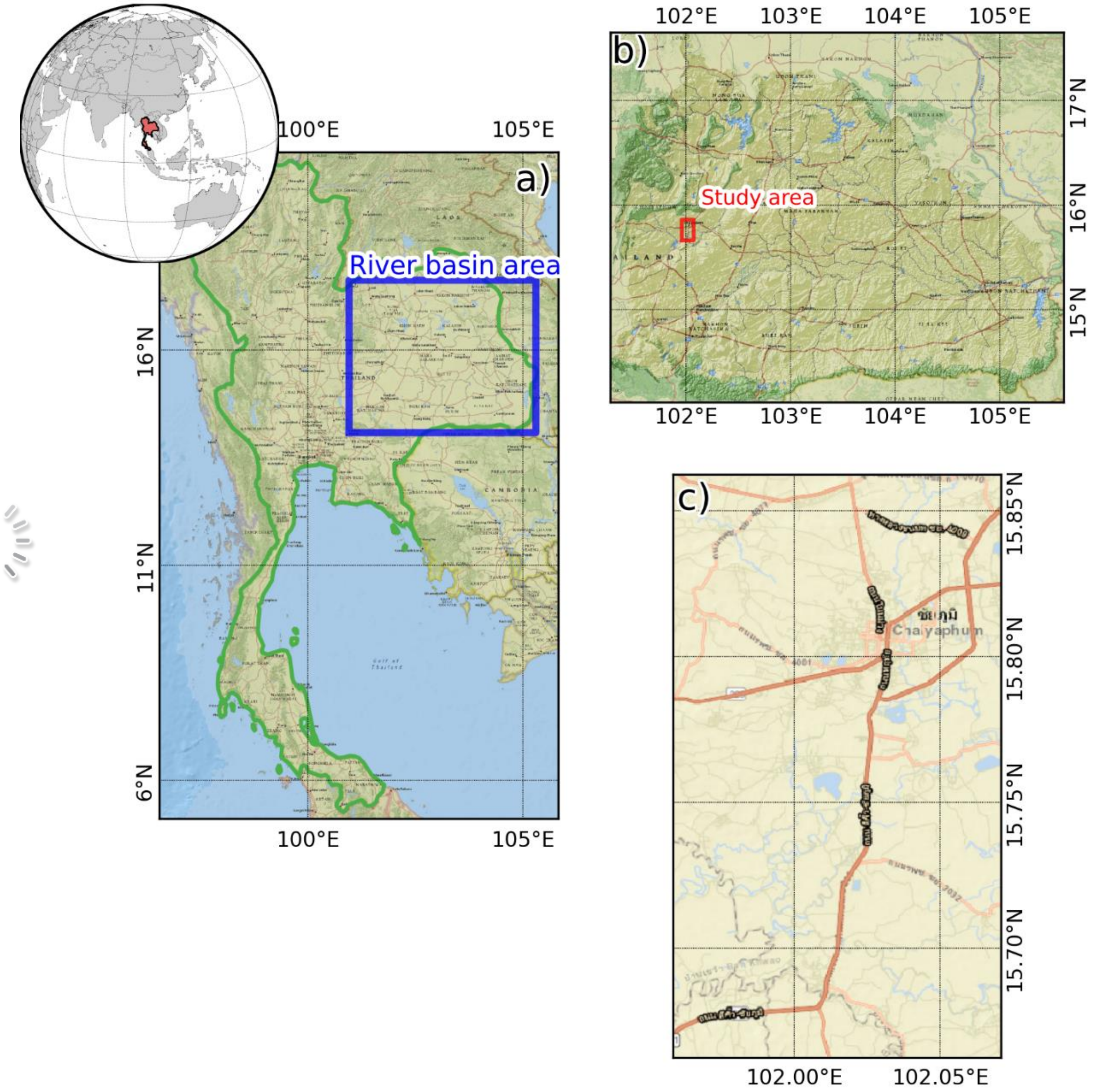


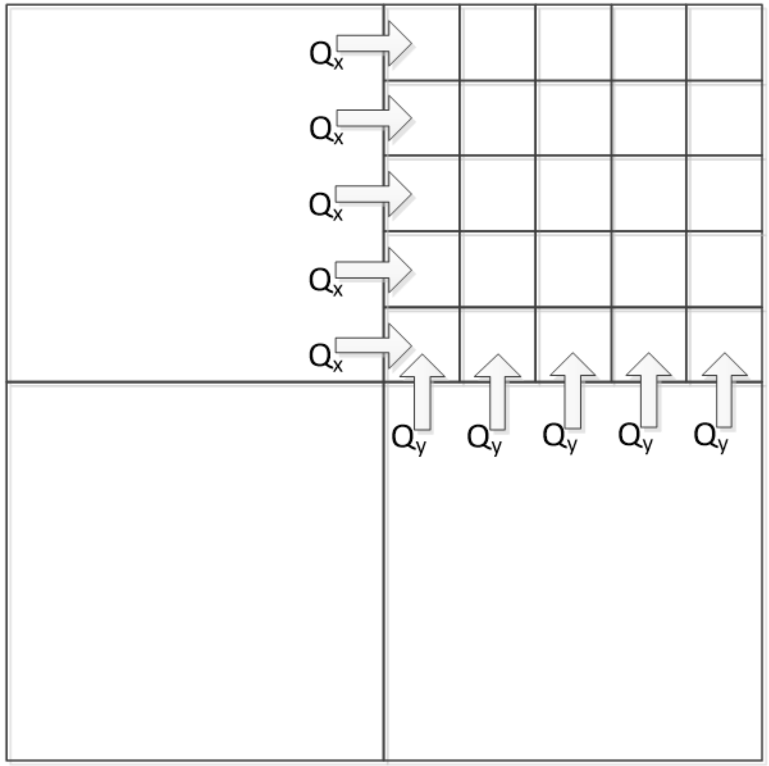
Fig. 1. Study area, a) the location of the Chi river basin in Thailand is the blue box, b) the area of the blue box as the river basin scale modeling that the study area as the detailed modeling is the red box and c) the area of the red box is in the upstream area of the Chi river basin, including Chaiyaphum City.

3. Methodology (Flood model)

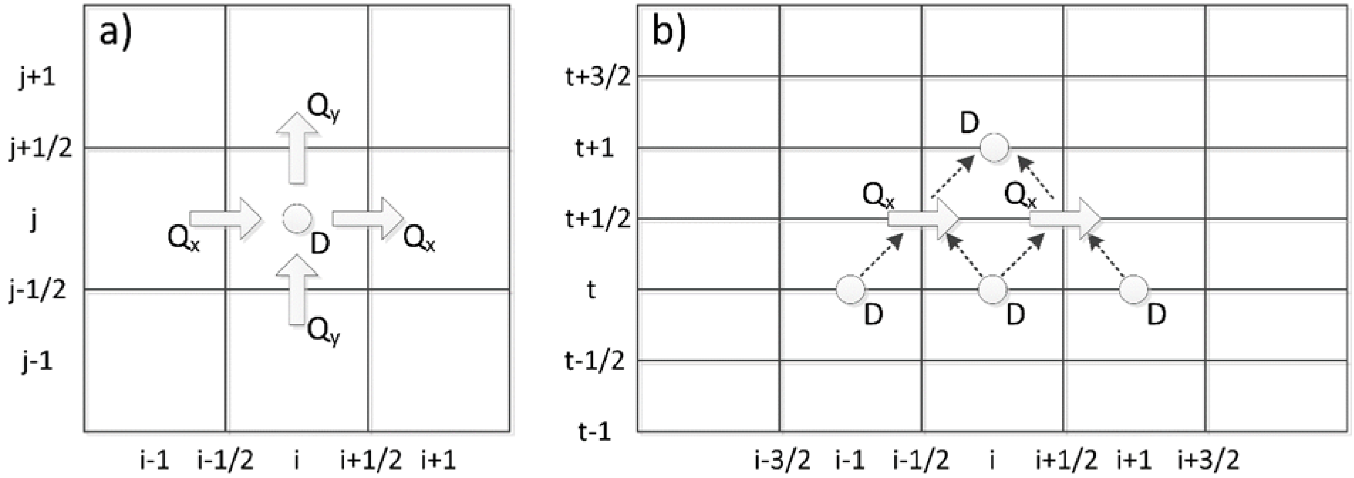
$$\frac{\partial D}{\partial t}+\frac{\partial Q_x}{\partial x}+\frac{\partial Q_y}{\partial y}=R+I \tag{1}$$

$$\frac{\partial Q_x}{\partial t}+gD\frac{\partial Z}{\partial x}+\frac{gn^2}{D^{7/3}}Q_x\sqrt{{Q_x}^2+{Q_y}^2}=0 \tag{2}$$

$$\frac{\partial Q_y}{\partial t}+gD\frac{\partial Z}{\partial y}+\frac{gn^2}{D^{7/3}}Q_y\sqrt{{Q_x}^2+{Q_y}^2}=0 \tag{3}$$

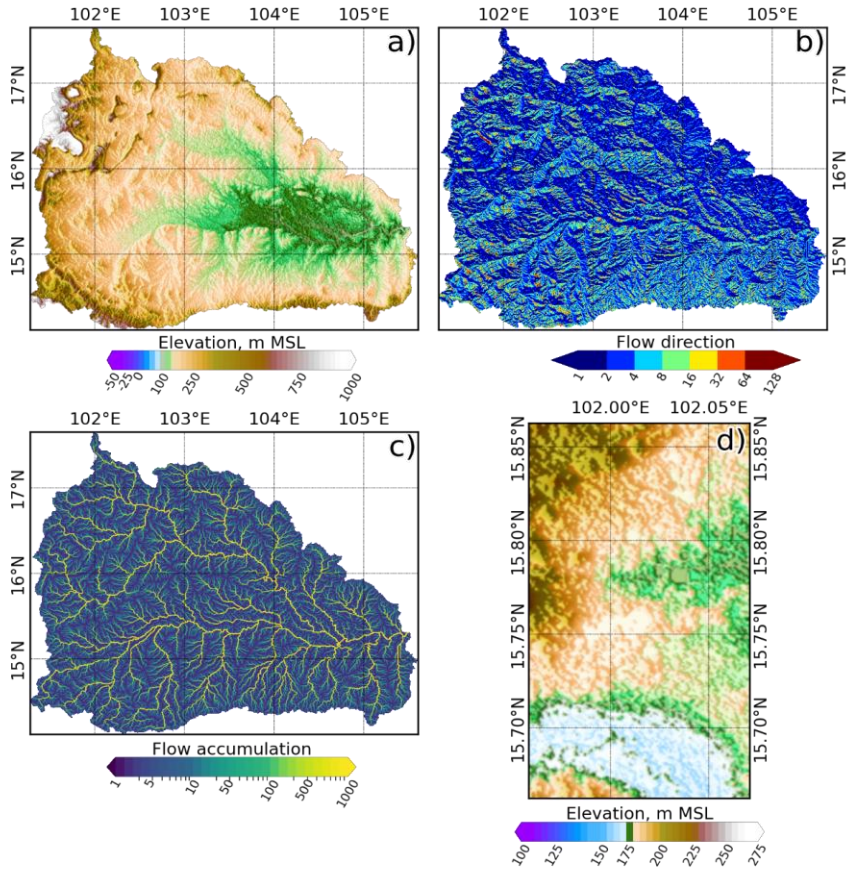


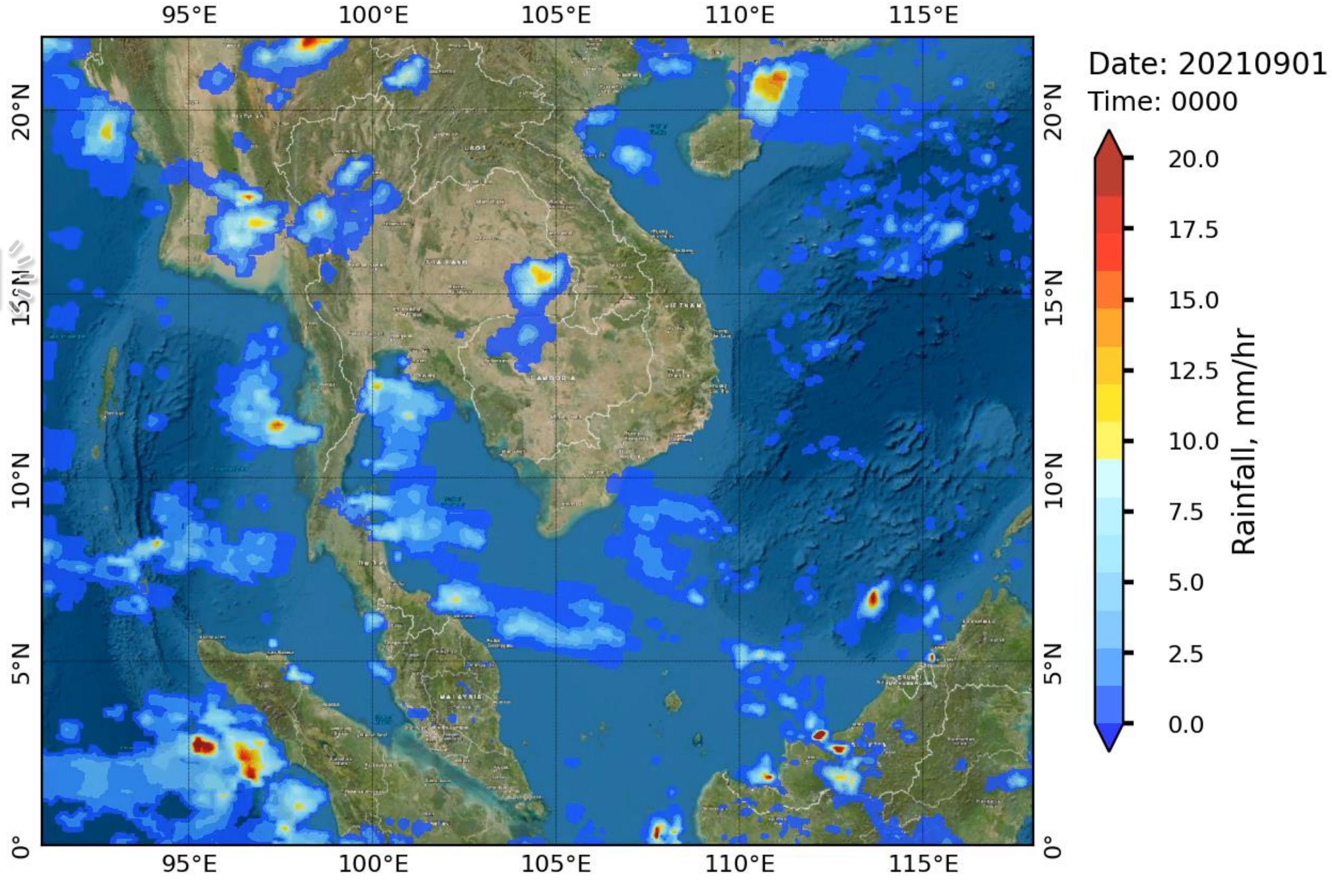
The linkage modeling between large and small resolution model.



Conceptual of flood modeling, a) The spatial geometry of the Staggered grid, b) The Staggered grid in the time domain

3. Methodology (Input dataset)

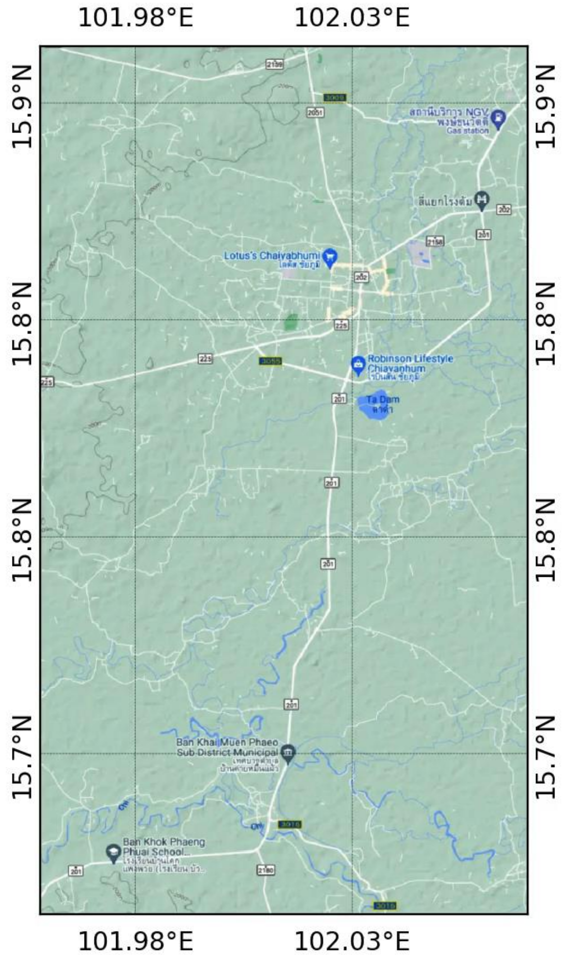


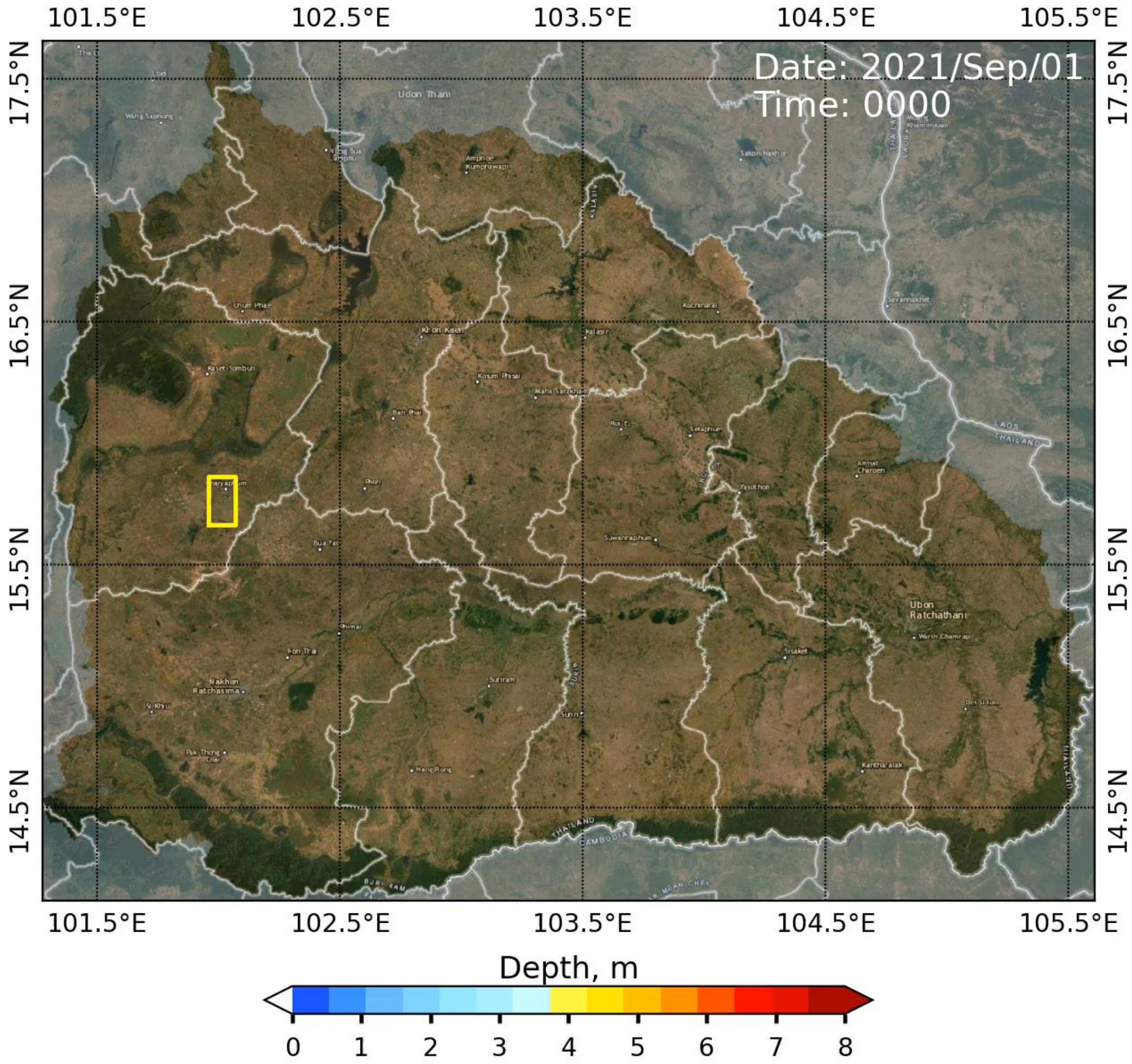


a) DEM (HydroSHED 15 arcsec), b) flow direction and c) flow accumulation, for the flood river basin model, while d) DEM for the small flood area SRTM 3 arcsec.

September to October, that is the rainfall duration used to do the flood simulation. The used rainfall is the GSMaP of 0.1 deg @ 1h.

4. Flood model result





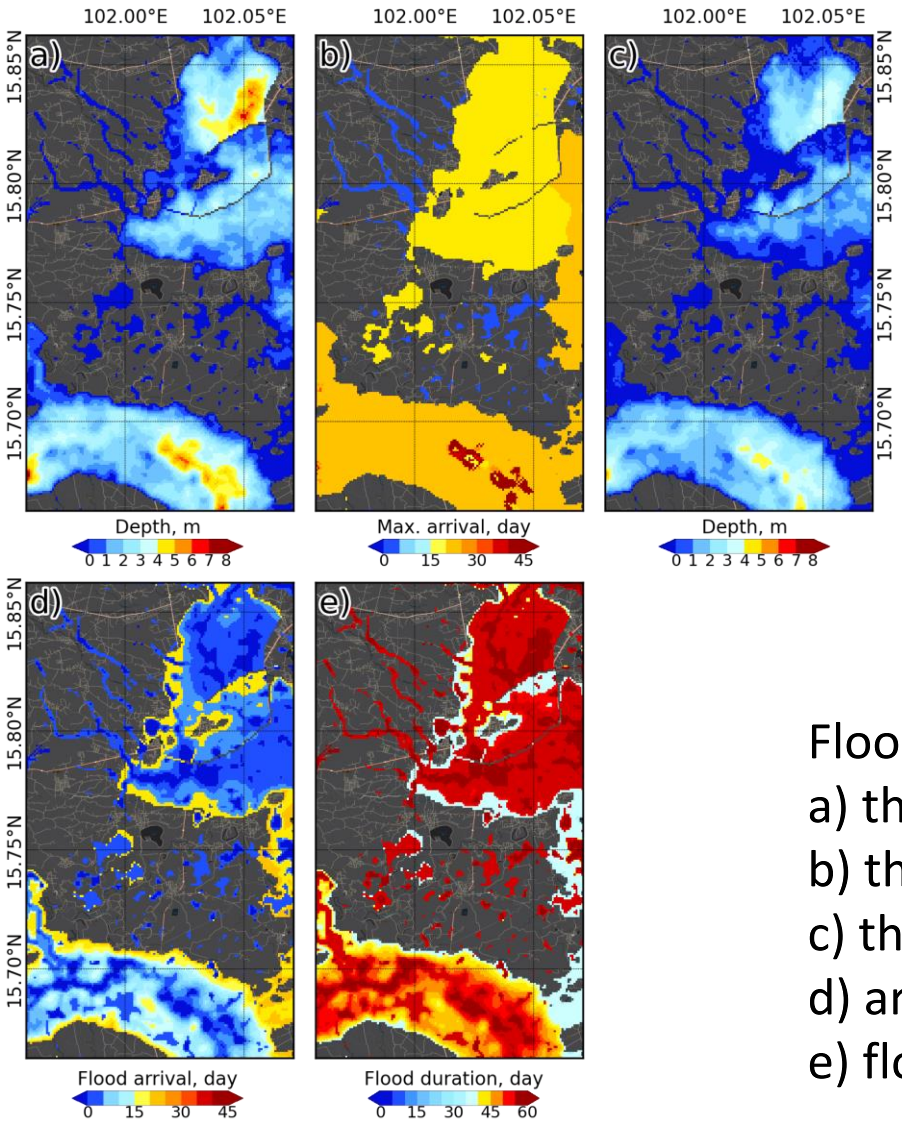
Model : Nesting SWE
Sim. Time : 60 days
DT : 0.001 – 60.0 sec

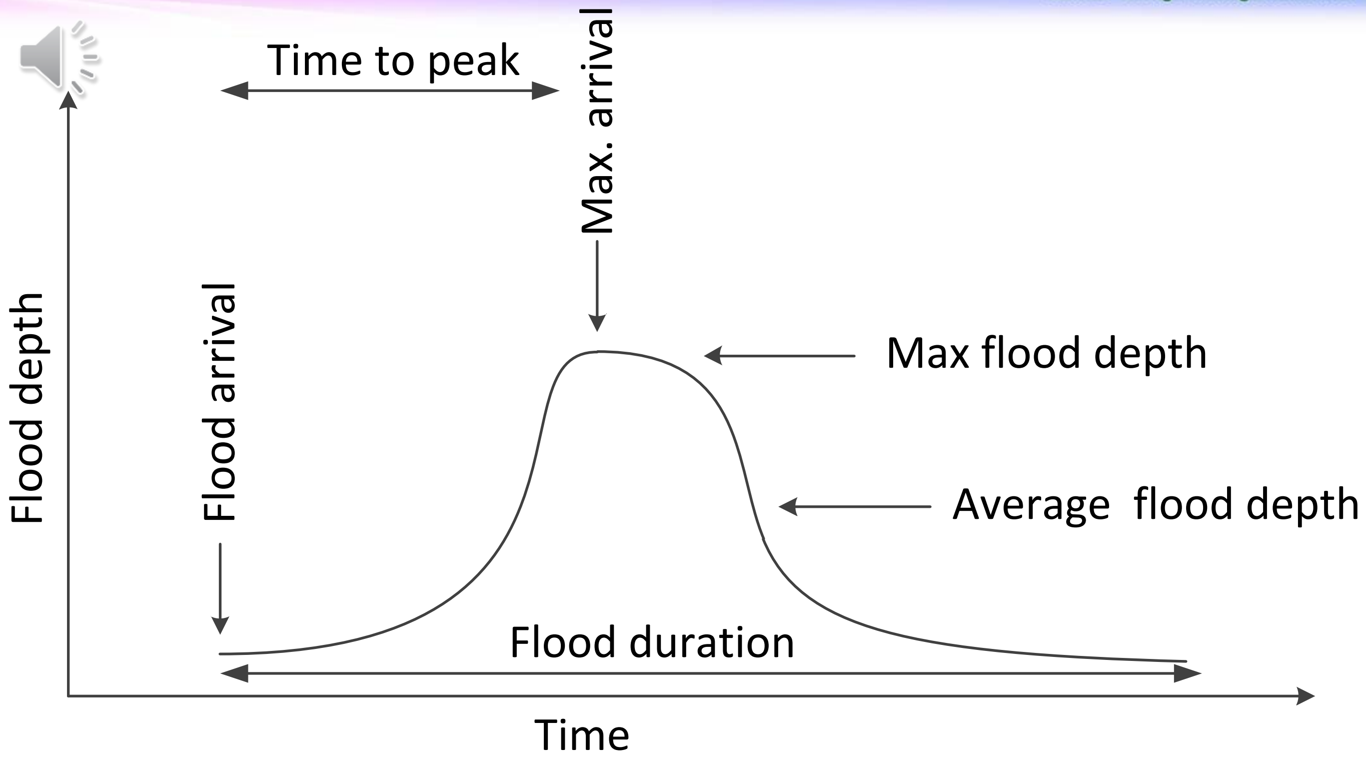
Large area : 15 arcsec (HydroSHEDS)
Small area : 90 m (SRTM)

n manning : 0.025

Rainfall : GSMaP

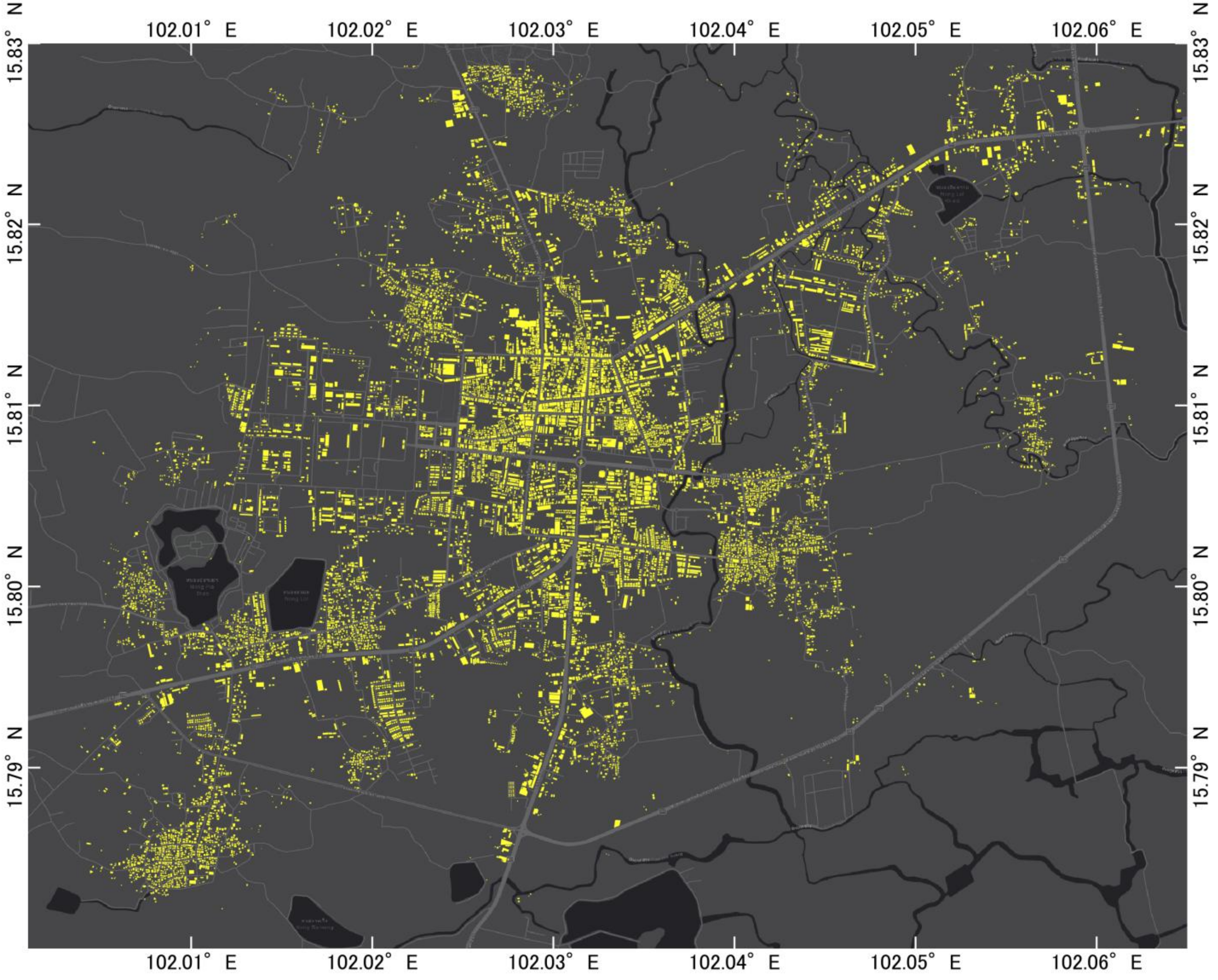
5. Flood hazard map

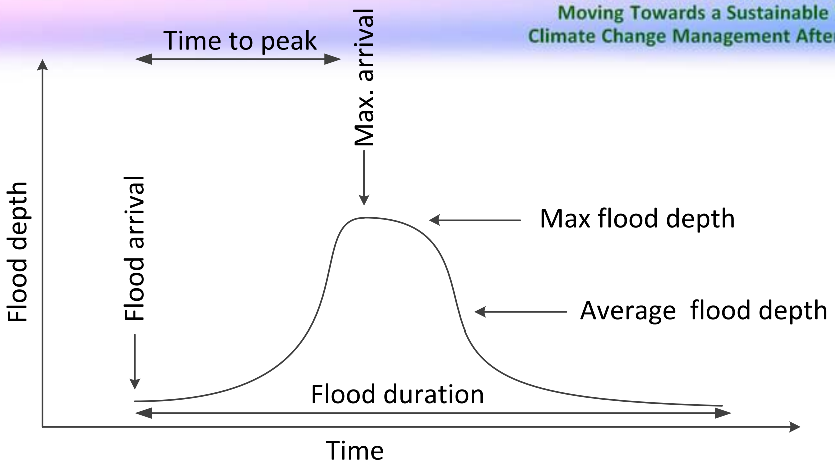




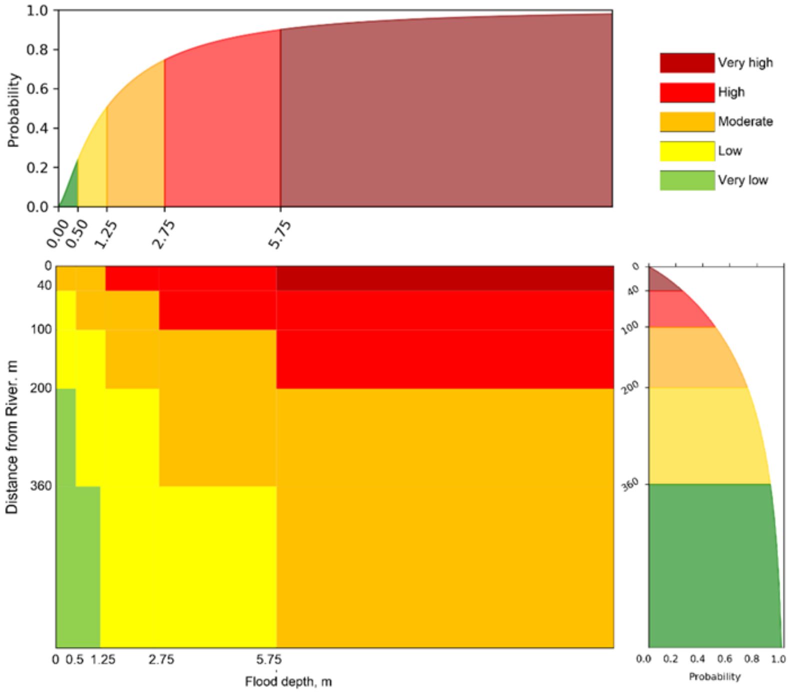
Flood characteristics during the selected event in the small region,
a) the maximum flood depth,
b) the arrival time of maximum depth,
c) the average flood depth during the event,
d) arrival time of flood depth as the flood beginning,
e) flood duration time.

6. Discussion on building hazard map based on the flood characteristic





Flood hazard identified by the **matrix approach** to combine 2 variables (*Jaboyedoff et al., 2014; Pakoksung, 2016*)



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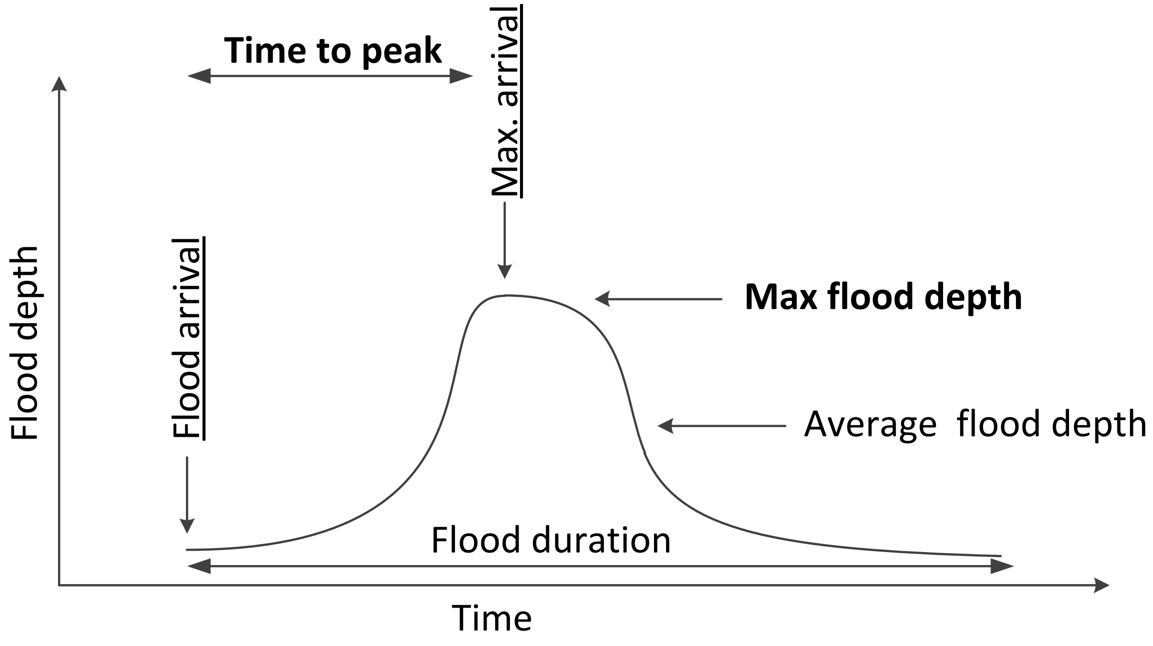

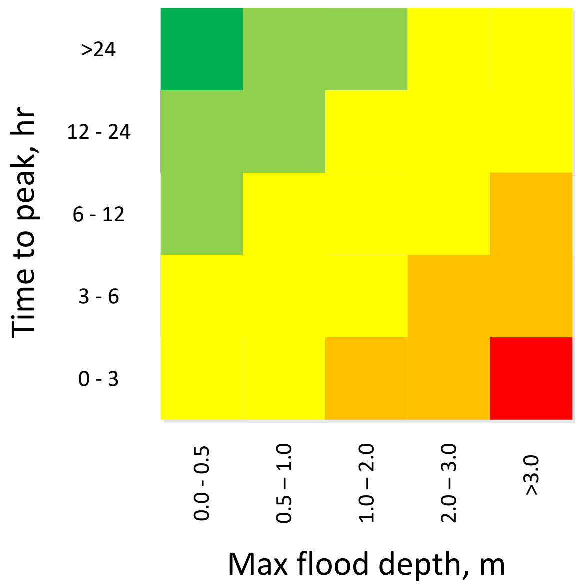

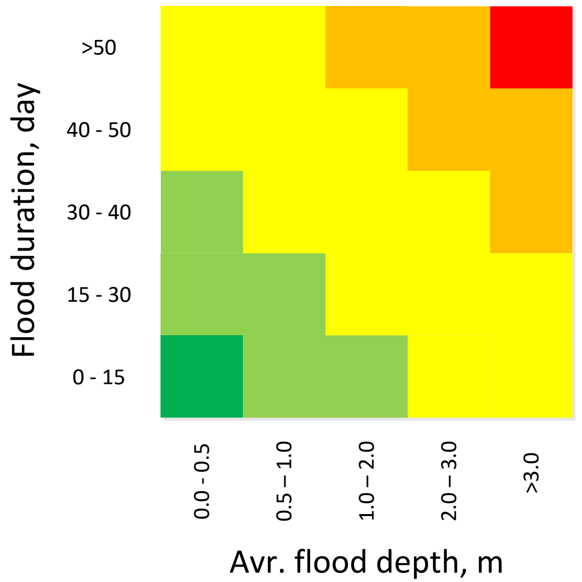

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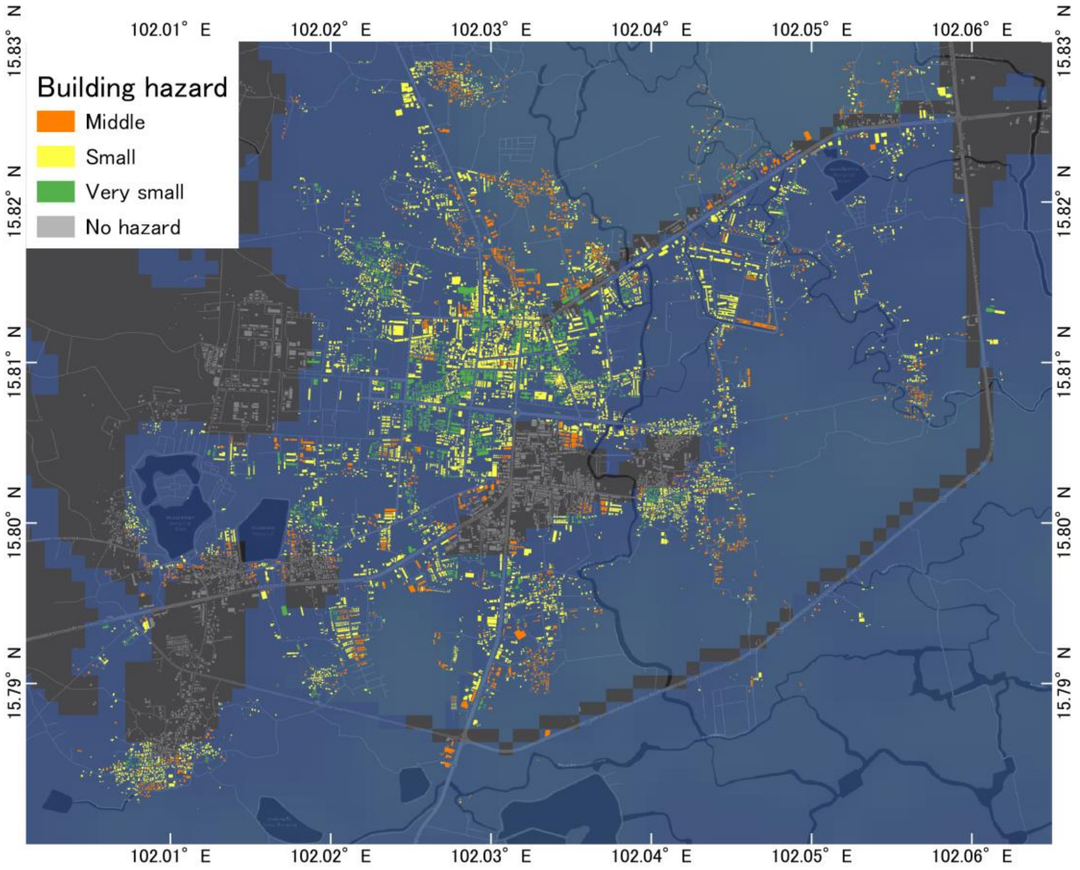
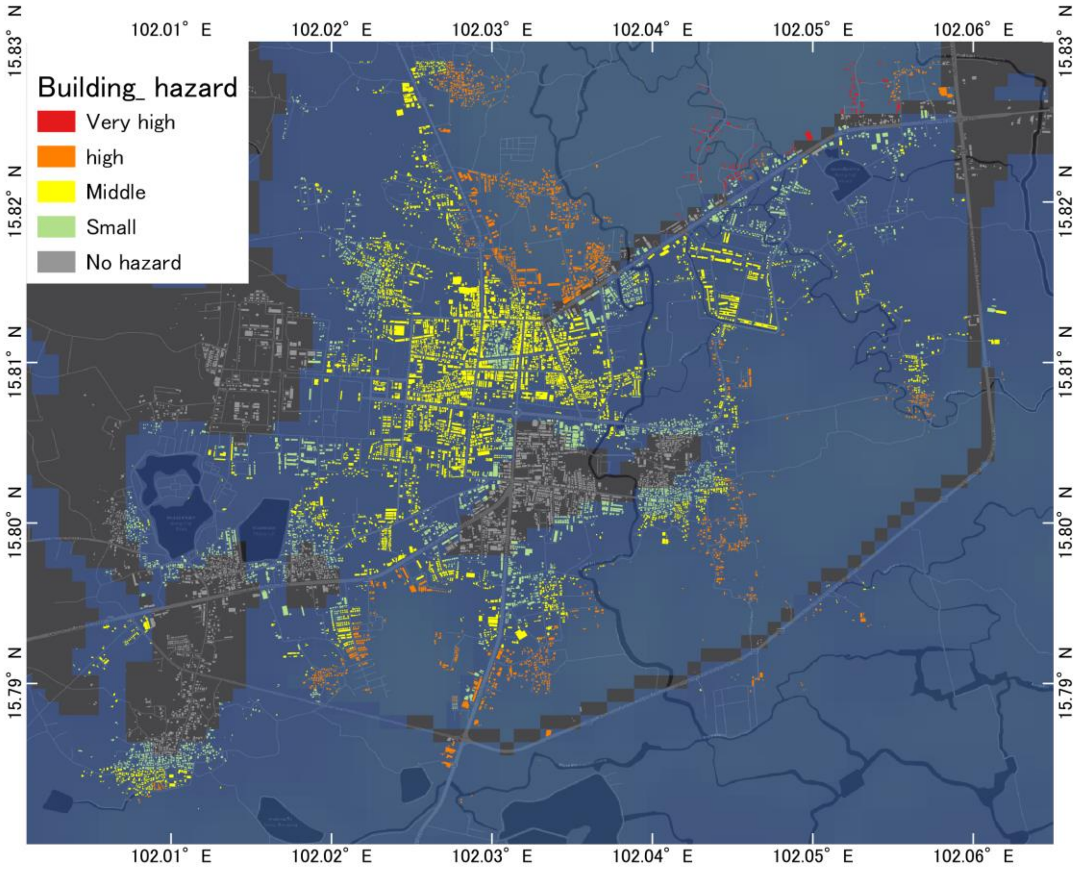


Building hazard map based on flood peak and time to peak that can be used for the evacuation in a pre-flood event.



Building hazard map based on average flood depth and flood duration time that can be used for the repairing after flood gone in a post-flood event.

7. Conclusion

- Flood in the Chi-Mun river basin was developed by the SWE and the model used nesting method to model the flood in a local scale in the Chaiyaphum city.
- The input dataset were limited by the topography used (HydroSHED and SRTM) and rainfall (GSMaP).
- Based on the simulated flood characteristic, it used to identify a flood hazard map for pre and post event.
- The flood hazard map is the one material used to manage the flood in future.

- The model in this study was done without the calibration with the survey data that is the recommendation for the future study.

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Thanks you very much