II－53 Inundation Model Application in Yom River Basin

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1. Introduction

Floods are one of the most life threatening natural hazards on the earth. It is an inevitable natural phenomenon occurring from time to time in all rivers and natural drainage systems, which not only damages the lives, natural resources and environment, but also causes the loss of economy and health. The impact of floods has decreased development on floodplain.

Damage from flooding is increasing each year resulting in the loss of lives, property and production as well as affecting activities in the flooded areas. Large and long duration of flooding can be considered as the economic loss of the country. Information from GIS can be used to extract some types of information, which are otherwise difficult to access by traditional methods, particularly for floodwater movement. This present study implies the application of Geographic information Systems(GIS) technologies to develop a inundation model.

2. Inundation Model

The inundation model is based upon the flow equations of continuity and momentum which can be rewritten as follows.

Continuity equation:

$$\gamma \frac{\partial D}{\partial t} + \frac{\partial \gamma M}{\partial x} + \frac{\partial \gamma N}{\partial y} = 0$$

Momentum equations in x and y directions:

x directions:

$$\lambda \frac{\partial M}{\partial t} + \frac{\partial}{\partial x}(\lambda \frac{M^2}{D}) + \frac{\partial}{\partial y}(\lambda \frac{MN}{D}) + \gamma g D \frac{\partial (D+h)}{\partial x}$$

$$+ \gamma g n^2 \frac{M\sqrt{M^2+N^2}}{D^{\frac{7}{3}}} + \frac{1}{2}\frac{(1-\gamma)}{B} C_D \frac{M\sqrt{M^2+N^2}}{D} = 0$$

y directions:

$$\lambda \frac{\partial N}{\partial t} + \frac{\partial}{\partial x}(\lambda \frac{MN}{D}) + \frac{\partial}{\partial y}(\lambda \frac{N^2}{D}) + \gamma g D \frac{\partial (D+h)}{\partial y}$$

$$+ \gamma g n^2 \frac{N\sqrt{M^2+N^2}}{D^{\frac{7}{3}}} + \frac{1}{2}\frac{(1-\gamma)}{B} C_D \frac{N\sqrt{M^2+N^2}}{D} = 0$$

where $\lambda = \gamma + (1-\gamma)C_M$, D = water depth ,
h =bottom level,t = time, M,N : density flow in x,y axis , g = gravity, C_D = drag coefficient

2D-overland flow model was developed to determine the water level . The Leap-Frog finite difference scheme method is used to solve the partial differential equations governing the flow processes.

3. Model Application

The river basin selected for this study is the Yom River basin, located in the Central-Northern part of Thailand between longitude 99.5°E to 100.5°E and latitude 15.6°N to 19.4°N(Figure 1). The overall watershed of the Yom Basin is 23,616 sq. km. Usually the occurrence of flood causes by overflowing from the bank of the Yom River ,starts from the mid to late of wet season that lies from the upstream part at Sukhothai via Phitsanulok, Phichit, and joins to the Nan River at Nakhonsawan Province.

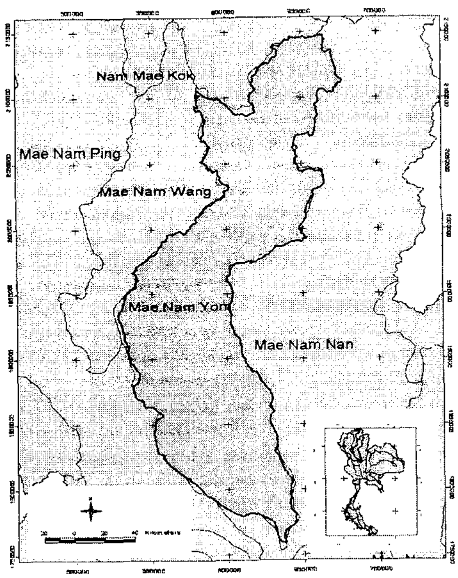

Fig.1 Yom River Basin, Thailand

Main input datasets for the 2D inundation model are rainfall , elevation and landuse data . In this study, the resolution of DEM is 1 km.There are twenty-one categories of landuse in this area .Due to less representation of some types of landuse and due to similar hydrologic behavior of some other kinds of landuse ,the landuse has been reclassified into 5 representative classes as shown in Table 1.Daily rainfall at twenty-one rain gauge stations which collected from Royal Irrigation Department .Theissen polygon is used to find out the spatial distribution of these rainfall stations(shown in Figure 3)

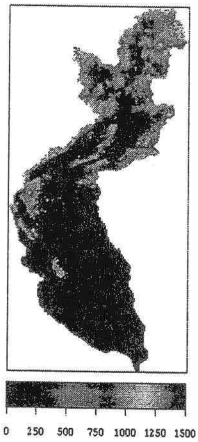

Fig 2. DEM of Yom Basin (1 km resolution)

Table 1 Types of Landuse and their contributions (%)

No	Landuse	Area(%)
1	Paddy field,Cropland	49.95
2	Swamp, Marsh	0.49
3	Forest	46.73
4	Grass land	0.31
5	Urban and built up land	2.52

Fig 3. Theissen polygon of Yom Basin

4. Results

The hourly simulation has been carried out for 1995 from July to August .The simulated water level in Yom River basin every 6 hours (shown in Figure 4).

The results from the figure showed that inundation area in simulation was similar to actual inundation area.

In short term simulation initial water level of each computation point of the river should be known because it make well results in short term. In downstream elevation quite be flat then the results not well.

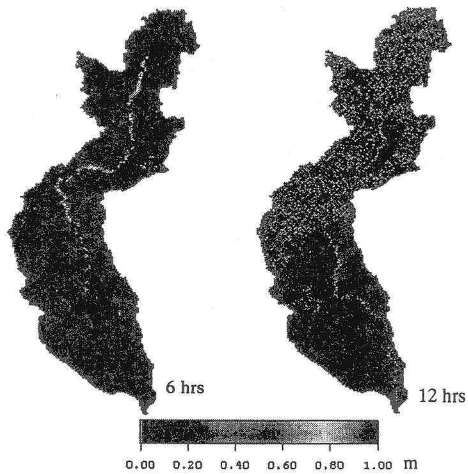

Fig 4. Simulated water level in Yom River basin

5. Conclusion

Inundation model are formulated based on the flow equations of continuity and momentum equation can be simulated inundation. In short term simulation, initial condition is necessary. The results in flat area can be improved by using higher resolution DEM and by other input data but the computation time so long. The results should be compared with remote sensing data in a flood event.

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