DEVELOPING OF DISTRIBUTED HYDROLOGICAL MODEL FOR THAILAND FLOOD 2011 AND FUTURE SITUATION OF FLOOD IN CHAO PRAYA RIVER BASIN UNDER THE IMPACT OF CLIMATE CHANGE

Kyoto University, Student Member ○ Supattana WICHAKU
Kyoto University, Regular Member Yasuto TACHIKAWA
Kyoto University, Regular Member Michiharu SHIIBA
Kyoto University, Regular Member Kazuaki YOROZU

1. INTRODUCTION

Due to the devastating flood occurred in Thailand from July 2011 until the end of year 2011, there are many losses in term of human loss, social loss, and economic loss. Therefore this study concentrates on studying of the flood and looking forward to the future under the condition of climate change whether the huge flood will occur.

The Chao Phraya River originates in the north region of Thailand and flow direction is from north to south. There are two parts of the Chao Phraya River basin, upper and lower part with an area of 157,925 km^2.

The upper part of the basin consists of four main sub-basins, Ping River, Wang River, Yom River and Nan River basin. The confluence of Ping and Nan River at Nakorn Sawan province in the central of Thailand is the beginning of the Chao Praya River.

This study is to develop the distributed hydrological model (1K-FRM), which can reproduce the phenomena of flood in year 2011, and to apply the model for a further study of future flood situation under the impact of climate change in the Chao Praya River basin.

2. METHODOLOGY

The rainfall data of 26 stations over the Chao Praya River basin were obtained for analysing an origin of the amount of the runoff, which is the cause of inundation in the Lower Chao Praya River basin in 2011. Rainfall data analysis was conducted by considering the accumulated rainfall data of year 2011 with the accumulated average rainfall of year 1980 - 2009 (30 years) and year 2010.

From the above process, it can be summarized that whether the flood situation in the lower of Chao Praya basin mainly depends on a volume of the runoff generated by the precipitation in the upper part of the Chao Praya basin.

Originally, Tachikawa Y. et al (2010) initiated and developed the distributed hydrological model, 1K-FRM, based on combination of the watershed model and the flow model. The spatial resolution 3 arc-second (about 100 m) of a digital elevation model (DEM) was used in the watershed model. Moreover, the kinematic wave model was also applied for the watershed model.

A simple water balance model for the catchment, which was developed by Nirupama et al. (1996) using the concept of the Variable Infiltration Capacity (VIC) Model, is utilized in this study by embedding the water balance model into the 1K-FRM.

Flow of Chao Phraya River Basin is significantly influenced by the operation of two main dams in the Ping River basin (Bhumiphol Dam) and Nan River Basin (Sirikit Dam) (Tachikawa et al, 2004). Consequently, this study also considers and includes the effect of those reservoirs in the 1K-FRM model.

For the model calibrating and validation, rainfall discharge and evapotranspiration, and in/outflow of the Bhumiphol dam and the Sirikit dam were obtained in the large flood years 1995, 2002, 2008, 2010, and 2011.

After the model validation process, the further step is to simulate the future situation of river discharge in the Chao Praya River under the impact of climate change.

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Contact address: Graduate School of Engineering, Kyoto University, C1-116, Nishikyo-ku, Kyoto 615-8540

The input data of the generated rainfall will be obtained by Global Climatic Model (GCM) from the Japan Meteorological Agency (JMA).

3. RESULTS AND DISCUSSION

The results of the rainfall data analysis are shown in Figure 1. Those sub-figures show that the amount of rainfall of year 2011 in the northern sub-basins is significantly higher than those of the averaged 30 years (1980-2009) and year 2010 approximately 36% and 32%, respectively. Whereas, the amount of rainfall of year 2011 in the Lower Chao Praya River basin is slightly higher than the average 30 years and year 2010 only 2% and 24% by order.

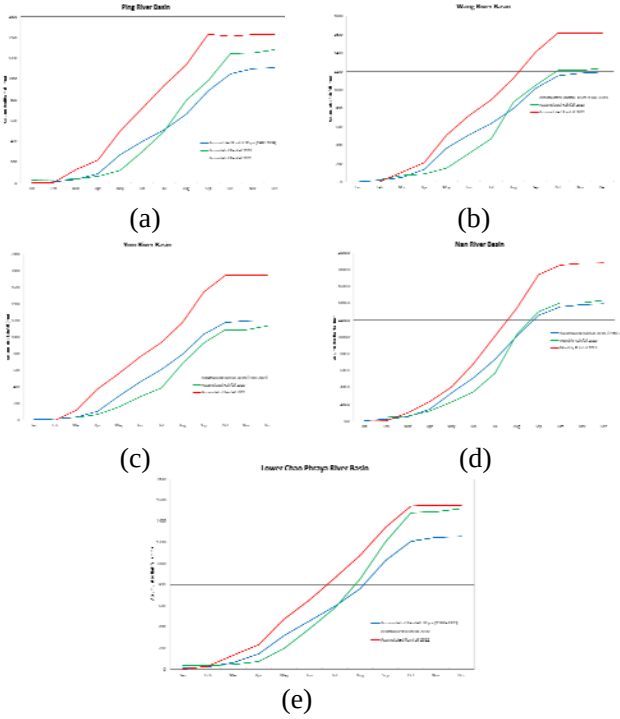

Figure 1. Accumulated rainfall of the averaged 30 yrs. (1980-2009), 2010 and 2011 in mm. for Ping River Basin (a), Wang River Basin (b), Yom River Basin (c), Nan River Basin (d), Lower Chao Praya River Basin (e)

This rainfall data analysis proves that flood 2011 in Thailand is mainly caused by the runoff from the upper part of the Chao Praya River basin. Therefore, our study area focuses on the runoff occurring in the upper part of the Chao Phraya River Basin, where the outlet is at Nakorn Sawan, C2 point.

1K-FRM was implemented for generating the river discharge during year 2011 in the Chao Praya River at C.2 Point as shown in the Figure 2. The volume of the river discharge simulated by the 1K-FRM is greater than the observed discharge as shown in the Figure 1.

This means that 1K-FRM is only routing model without considering any losses. Thus we have to develop the model by combining the model with water balance model, reservoir simulation model as described in the methodology.

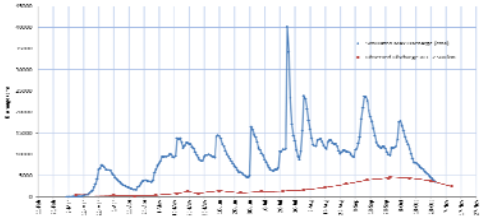

Figure 2. Comparison of Simulated and Observed Maximum Daily Discharge of the Chao Praya River at Station C.2 during year 2011

Presently, the embedded models, water balance and reservoir simulation model, for generating the direct runoff and the river discharge are under developing for the further research.

The expected result of the study is to acquire the distributed hydrological model and the set of the model parameter, which well represent the characteristic of the hydrological process in the Chao Praya River Basin. The developed distributed model will be applicable for simulating the future flood situation in the Chao Praya River basin under the impact of the climate change as well.

4. REFERENCES

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