II－15 Evaluation of annual temporary water storage distribution in the Lower Mekong River basin

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1. Introduction

Watershed physical characteristics such as morphology, geology, soil and land use along with precipitation control the hydrological processes in a watershed. Modelling of hydrological processes is not an easy task even in physically based distributed models due to complex governing processes and loss of information in descaling. In addition temporary water storages due to irrigation and reservoir operations are obscure in large watersheds making modelling of hydrological process in large basins arduous task (Nawarathna et. al, 2001).

Modified BTOPMC (Block wise use of TOPMODEL with Muskingum-Cunge flow routing method) is a physically based semi distributed runoff model method (Takeuchi et al., 1999). Differences in observed and simulated daily runoff in five sub basins along the Mekong River (Figure 1) are used to evaluate typical temporary annul water storage distributions in both reservoirs and irrigated land.

2. Study site and Data set

The twelfth longest river in the world, the Mekong River meandering through six countries in Southeast Asian region was chosen for this study. Hydro-meteorological data sets were collected from Mekong River Commission (MRC) 1993 yearbook. Daily observed runoffs at six gauging stations: Luang Prabang (268 000 km^2), Nong Kai (302 000 km^2), Nakhon Phanon (373 000 km^2), Mukdahahn (391 000 km^2), Khong Chiam (419 000 km^2), and Pakase (545 000 km^2) were extracted together with rainfall records.

Earth Resources Observation System (EROS) Data Center of the U.S. Geological Survey has developed 1-km resolution global land cover characteristics. Land use and elevation data were extracted from these data sets using detected basin boundaries by the program.

3. Results and Discussions

Beven and Kirkby (1979) proposed the TOPMODEL based on contributing area concept in hill slope hydrology. BTOPMC model was developed in the Yamanashi University, Japan adopting block wise parameterisation of TOPMODEL. Percentage of

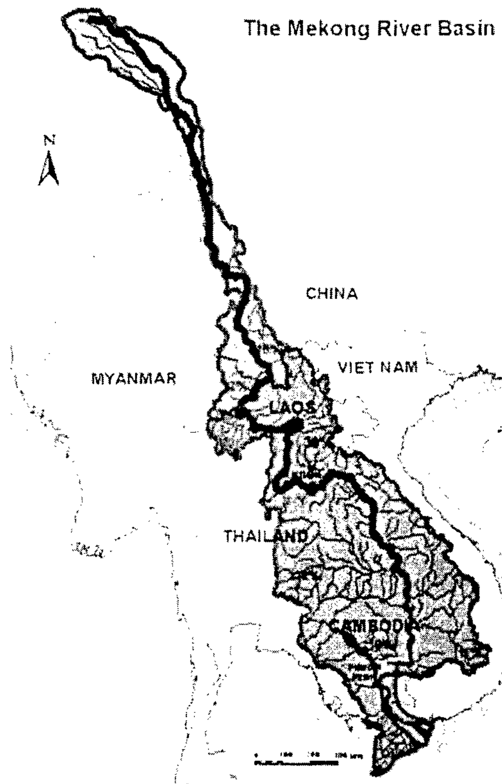

Figure 1. Study Area

irrigated fields and water bodies was extracted from the land uses derived from Biosphere-Atmosphere Transfer Scheme (BATS) is shown in the Table 1. The model was calibrated according to the land use distribution in each block and also to have Nash Coefficient of higher than 0.8. Hydrograph for the effective watershed results at Pakse discharge measuring station for the year 1993 are shown in Figure 2. The Most down stream sub basin mainly consists of irrigated feilds where as upstream sub basin consists of a very few irrigated lands and inland water bodies. Though reservoir area does not necessarily

Table 1. Sub basins Land use distribution in km^2

Land Use type	Khong Chiam to Pakse	Mukdahan to Khong Chiam	Nakhon Phanon to Mukdahan	Nong Kai to Nakhon Phanon	Luang Prabang to Nong Kai
Irrigated Crops	101477 (80.5%)	6323 (22.6%)	2929 (16.3%)	18492 (26.0%)	3694 (10.9%)
Inland Water	1696 (1.3%)	152 (0.5%)	170 (0.9%)	1437(2.0%)	360 (1.1%)
Total area	126000	28000	18000	71000	34000

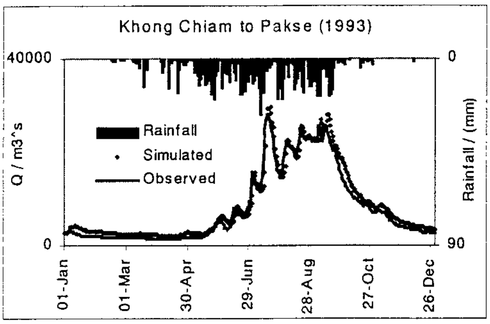

Figure 2: Simulated Hydrograph from Khong Chiam to Pakse

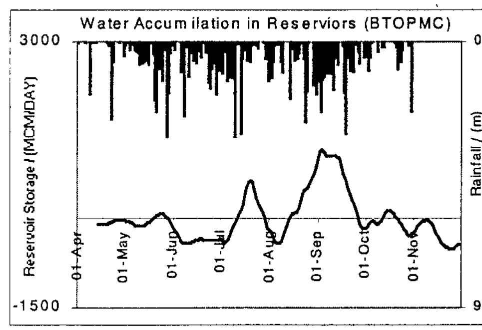

Figure 3 : Estimated Water accumulation pattern in reservoirs (BTOPMC)

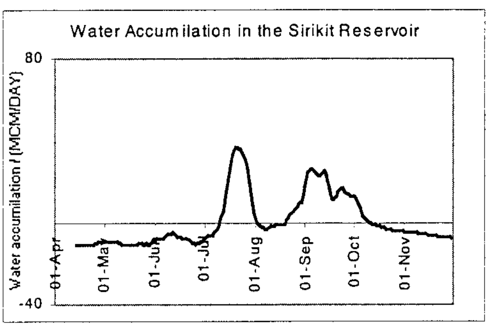

Figure 4: Water accumulation pattern in the Sirikit reservoir

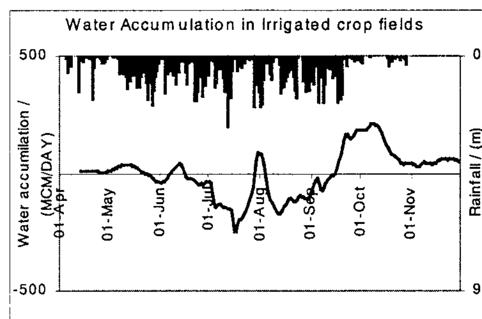

Figure 5: Estimated water accumulation pattern in irrigated crops from BTOPMC

represent the reservoir capacity, it can be use to detect reservoirs with significant capacity.

Mekong reach from Luang Prabang to Nong Kai (530 km) feed from 34 000 km^2 watershed consists of a very few farming or irrigated croplands and there are not any reservoirs with significant capacity in its catchment. In the analysis the differences between observed and simulated runoff are due to basic errors in information de-scaling and the model concept. From Nong Kai to Nakhon Phanon, there are four major reservoirs. Which are: Nam Ngun, Huay Luang, Nam Un and Nuong Han. Effective watershed for the 452 km main stream is about 71 000 km^2. Simulation results of this watershed are used to evaluate temporary water accumulation pattern in storage reservoirs (Figure 3). Sirikit is a storage reservoir in the Mekong river basin. Water accumulation in this reservoir estimated from the daily reservoir storages is shown in the Figure 4. There is hardly any rainfall from December to March causing less temporary storage activities. The estimations are carried out from April to end of November. Both Figures 3 and Figure 4 show similar patterns and once this reservoir activities coupled with the model, the expected results has to be comparatively better. The 131 km mainstream from Khong Chiam to Pakse is fed from 154 000 km^2 catchment. This sub basin is full of paddy fields (80%). There are several reservoirs in this watershed. We assumed that the water accumulations in those reservoirs are negligible compared to the irrigated fields. Simulation results at this station were used to estimate water accumulation pattern in irrigated crop fields. But these results might have the influence of temporary storage by reservoirs in its watershed.

4. Conclusions

Water accumulation pattern in the storage reservoirs and irrigated crop fields were estimated using both observed and simulated runoff by BTOPMC model. Results are compared with the actual water accumulation at Sirikit reservoir. Methodologies should be addressed to incorporate temporary water storages in the basins to develop better hydrological models.

5. Acknowledgement

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6. References

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