Improving Runoff Estimates by Increasing Catchment Subdivision Complexity and Resolution of Rainfall Data in the Upper Ping River Basin, Thailand

Punpim Puttaraksa Mapiam* and Sutthiched Chautsuk

Department of Water Resources Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand

**Corresponding author. E-mail: fengppm@ku.ac.th*

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ABSTRACT

This study investigated the effect of different sub-division schemes and two rainfall data types – gauge and radar – on the accuracy of runoff forecasting using a semi-distributed hydrological URBS model in a large river basin with a limited network of rainfall gauges. The entire catchments at three runoff stations in the Upper Ping River Basin, Thailand, were employed initially as a single lumped unit, and each catchment was thereafter divided into four increasingly complex subdivision schemes. Model performance was compared using areal gauge rainfall data (from the sparse rain gauge network) and estimated, high-resolution, radar rainfall data across all catchment schemes over three periods; June-October 2003, May-September 2004, and May-July 2005. The results indicated that the accuracy of runoff estimates increased with increasing catchment subdivision complexity when using the high-resolution radar rainfall, but did not improve with the rain gauge data.

Keywords: Catchment subdivision, Radar rainfall, Rain gauge rainfall, Semi-distributed model

INTRODUCTION

Hydrological modelling is a non-structural tool for predicting water runoff in a catchment basin. The models are of three types: lumped, semi-distributed, and distributed (Cunderlik, 2003; Jajarmizadeh et al., 2012). The lumped model is the simplest; it assumes that precipitation and model parameters are uniform over the basin. The larger the basin and more variable its characteristics, the less accurate this model becomes (Koren et al., 1999). The semi-distributed model allows for partial spatial variations in precipitation, streamflow routing, and catchment by sub-dividing the catchment area; this improves predictive performance (Boyle et al. 2001). The distributed model allows the modeler to specify the spatial resolution over which to fully vary the model parameters; this provides the most accurate runoff estimates, but is highly complex, requiring significant data parameterization (Arnold et al., 1998).