Simulation of river discharge using 1k-DHM model in Myanmar

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1. Introduction

River flow condition is very important for various purposes such as irrigation, transportation, hydropower generation, flood prevention and others. It can obtain by ground observation, using rating curve or simulation using with hydrologic models. The former method is most reliable but rare for developing countries because of its high cost. In this case, the later method, simulation using hydrologic model, is one of solution for poor gauging river basin as a reference.

2. Methodology

1k-DHM is a kind of distributed hydrologic rainfall-runoff model based on a kinematic wave flow approximation considering with surface and subsurface flow components. Input data is rainfall, evaporation and it gives flow discharge as output. Kinematic wave model is applied to all slope and surface runoff is routed according to the flow direction information from Arc-GIS. These result is applied to each cell in 1K-DHM and each cell calculates stream flow using discharge from upper cells and flow direction is determined using topographical data provided HydroSHEDs.

Subsurface flow in saturated and unsaturated layers is considered in the discharge-storage relationship of a kinematic wave model. The discharge depth relation realizes three lateral flow mechanisms including (1) subsurface flow through capillary pore (2) subsurface flow through non-capillary pore and (3) surface flow on the soil layer.

At a slope surface, when the water depth is lower than the equivalent water depth for unsaturated flow, flow is simulated by Darcy law with an unsaturated hydraulic conductivity. If the water depth exceeds the equivalent depth for unsaturated flow, the exceeded water flows as saturated subsurface flow that is simulated by Darcy law with saturated hydraulic conductivity. If the water depth is greater than the effective soil layer, the water flows as surface flow, which is simulated by the Manning's equation. This model is created by hydrology and water resources research, Kyoto University.

Simulation of discharge using in 1k-DHM for Namlang river in Myanmar is approached in this paper. The purpose of this paper is to use simulated discharge for planning of hydropower generating. For hydropower implementation, river discharge is essential and high flood and low flow data is needed to design hydraulic structures and this plays a vital role. For this requirement, available meteorological data of existing near projects and hydrological stations are used.

Study area is located in Kyaukme District of Northern Shan state, eastern part of Myanmar. For require distributed rainfall data, 10 years daily rainfall data of nearest five stations and for evaporation average evaporation data for 13 years of nearest Kyaukme station are used in this simulation.

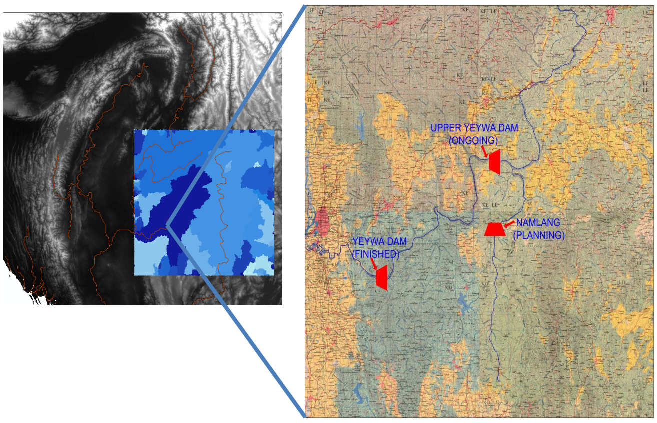

Figure 1.Location map of study area and stations

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3. Results and discussion

In this paper, 10 years simulation is carried out. For each year, first five months simulated discharges are a little lower than the result obtained by catchment area ratio because of potential evaporation. So, evaporation pan coefficient value 0.45 is used according to the handbook of hydrology. If this factor does not consider, simulation results is very small.

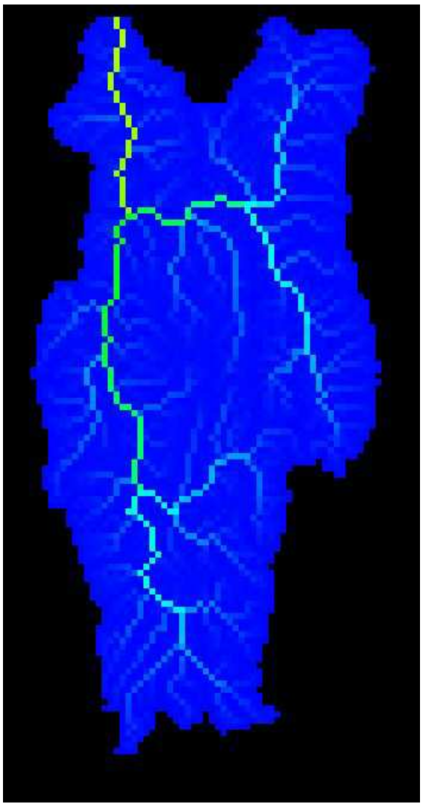

Figure 2. Simulated flow condition in study basin

For the whole simulation process, every year show same tendency but some have largely over estimated. This depends on the large size of catchment area and different topography and geography compare to Japan. Simulation results are shown as below.

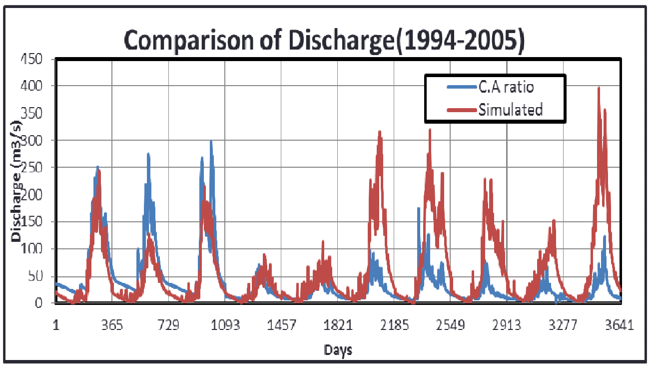

Figure 3. Comparison of Simulated Discharge with Catchment area ratio method

However, for low flow analysis by comparing flow duration curve and annual average discharge, the two results are nearly same. To get precise data, small catchment area, steep slopes and temperate climate condition is more prefer and it has some difficulties for some basins with opposite conditions and calibration is certainly needed.

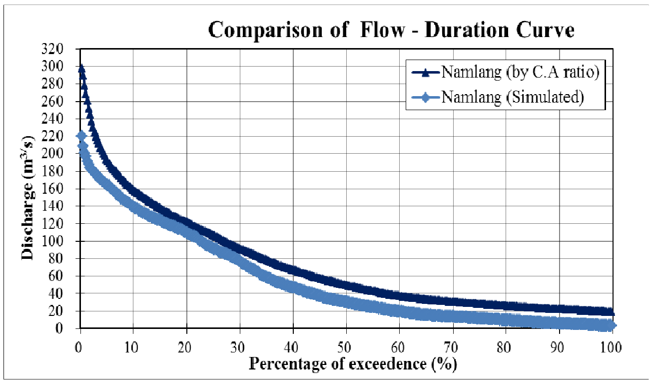

Figure 4. Comparison of Flow duration curve

Finally, if some modification can be carry out using with more efficient computer, hopefully the more reliable results can be simulated and these results can be used as a reference for very poor gauging basins.

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