



Effects of reservoir operation on daily flow regime in a tropical monsoon region: case study of the Upper Chao Phraya Basins in Thailand

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Reservoirs and dams have been a necessity for rational water management. Understanding reservoir operations and their quantitative effects on downstream discharge is essential for improving flood and drought prediction and control. Reservoir operations in the tropics differ from other hydro-climatic regions due to the seasonal monsoon, and therefore should be thoroughly examined in specific contexts. This research aims to assess how the tropical reservoir operations modify the daily flow regime, and alter the frequency and magnitude of extreme events in a mesoscale basin. We chose the Upper Chao Phraya River Basins (110,000 km²) in Thailand, which is prone to both monsoonal floods and El Niño droughts. The basin contains seven multipurpose reservoirs, of which the two biggest ones contribute to 93% of the water storage. Having been operated for over 45 years, the dams have regulated the downstream flow, but their roles on flood and drought mitigation have also been questionable. We used the novel fully-distributed wflow_sbm model with a reservoir operation module to simulate the river discharge in three scenarios: naturalized flow, regulated flow with the two major reservoirs, and regulated flow with seven reservoirs. Historical data of reservoir and river discharge observations from 1989-2014 (varying per station) were obtained from Thai authorities. The hydrological model was set up at the spatial resolution of 1 km². No calibration was needed as we based the model parameters on static maps. For the reservoir operation module, crucial parameters were manually calibrated. Since the basins contain few meteorological stations, we used the MSWEP precipitation dataset as forcing data. In comparative studies, we revealed the characteristics and downstream effects of the analysed dams, including the reduction in the exceedance probabilities of daily discharge and extreme event frequencies. The study also shows that the reservoir operations had a huge impact on the catchment water balance, which led to the difficulty in daily reservoir discharge simulations using the simple reservoir scheme. To apply the proposed model for the real-time forecasting and decision making system, a more complex reservoir scheme should be tested.