C206

Impacts of Reservoir Operation on Streamflow in the Vu Gia Thu Bon River Basin, Vietnam

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I. INTRODUCTION

For civilization to thrive sustainably, water is crucial. However, the security of the water supply is severely threatened by human activity and climate change. Direct human impacts were discovered to be greater than climate change consequences for various regions of the world, including Asia. Over half of the world's major river systems have been discovered to be impacted by dam and reservoir operations. Dam construction has detrimental effects on downstream ecosystems and inhabitants, including decreased species diversity, human resettling, community livelihood, and local socio-cultural relationships. Vu Gia Thu Bon River Basin (VGTBRB) has existing reservoirs that could have a negative impact on the ecosystems, a hydrological model was set up. Changes in simulated streamflow can therefore be ascribed to adjustments in reservoir operations.

2. STUDY AREA

We concentrate our research on the VGTBRB, one of Vietnam's biggest internal drainage systems, which is situated in Central Vietnam. A total of 10,000 km2 is covered by the VGTBRB, a river system formed by the Vu Gia river and Thu Bon river. Forest makes up about half of the land area. There are 18 multipurpose dams within VGTBRB. Figure 1 depicts the locations of 15 rainfall stations and 2 water discharge stations. Regarding water, food, energy, cultural, and recreational activities, the VGTBRB has a significant impact on the livelihood of the local populace. The long dry season frequently results in water shortages, while rainfall occurs for the entire four months of the wet season (from September to December).

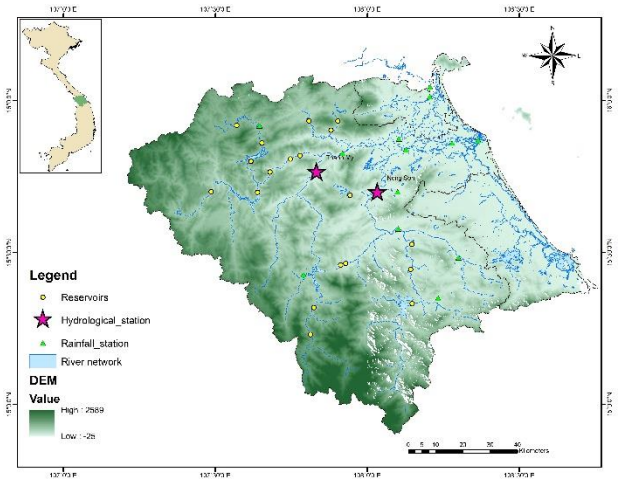


Figure 1: VGTB River Basin

3. Methodology

The methodology consists of two main steps: calibrating the VGTB HYPE model against observed streamflow before dam operation for the period of 2000–2009; and (ii) Validating the Hydrological Predictions for the Environment (HYPE) model against observed streamflow after dam operation for the period of 2016–2020. Theoretically, an integrated reservoir operation system mentioned by **Du et al., 2022** more thoroughly simulates reservoir operation (particularly the calculation of Qout) (IROS). Key performance indices including NSE and CC.

3. RESULTS

Figures 2 and 3 show a good correlation between measured and simulated flows at Thanh Mi and Nong Son stations. Model performance for the calibration period and validation period is acceptable, NSE value and CC value are both greater than 0.5. The performance of daily streamflow with and without reservoirs compared to observed streamflow is presented in Figure 4. Statistical performance improved significantly for the scenario with reservoirs. To quantify reservoir effects for the period from 2016 to

2020 (Fig. 5), we plotted the mean monthly values of the reconstructed streamflow against the naturalized discharges for the two stations. For Thanh My station located upstream of the Vu Gia River, monthly streamflow was reduced on average by approximately 70 m3/s. The impact of reservoir operation is most pronounced during the dry season. During the dry season, discharge decreased by 48%. At Nong Son station, the mean monthly streamflow increased by 9.87 to 44.1 m3/s for the period January to August. Although the mean discharge for September to December increased by 74 to 140 m3/s, the percentage increase was rather low.

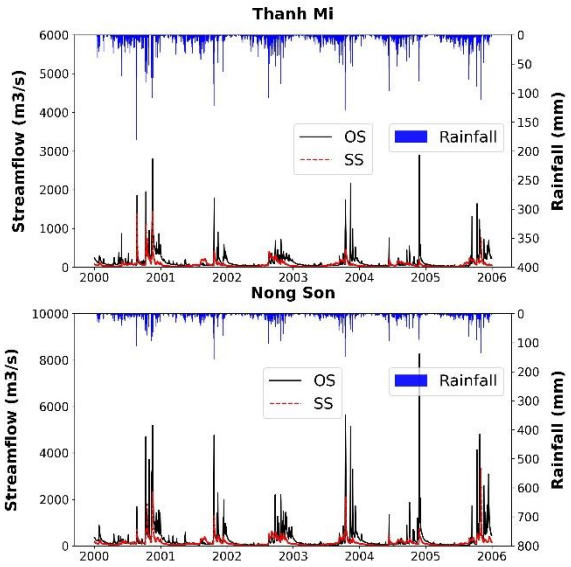


Figure 2: Model calibration 2000- 2005

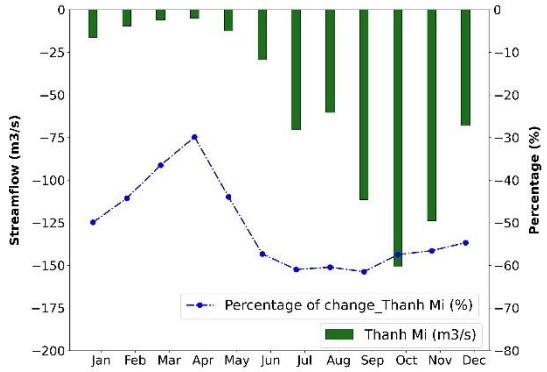


Figure 5: Reservoir impact on streamflow changes

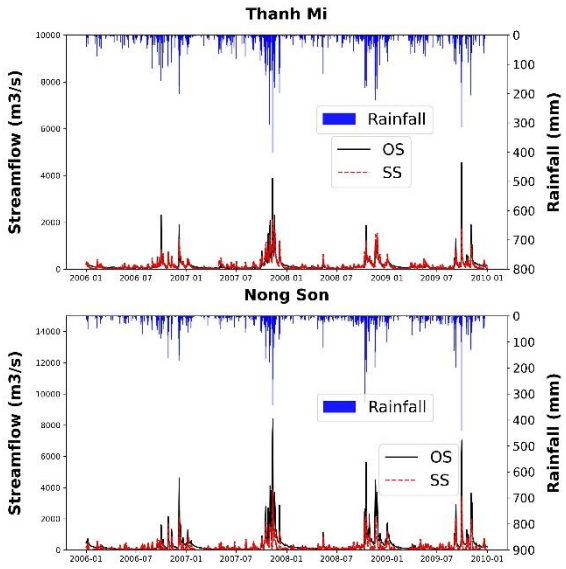


Figure 3: Model validation 2006- 2009

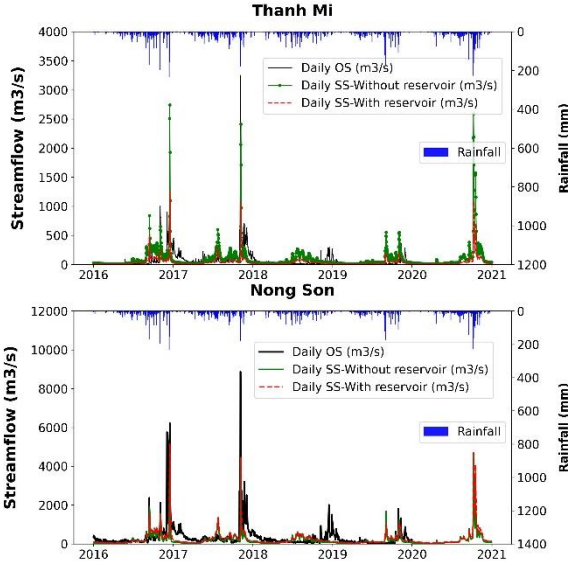
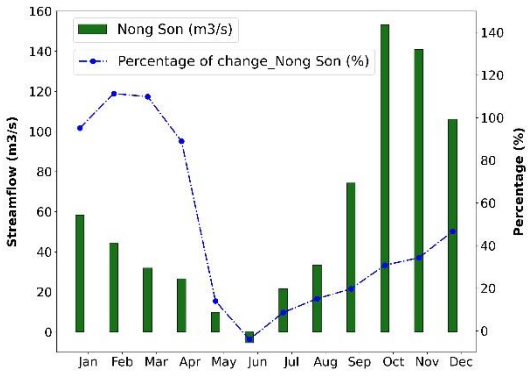


Figure 4: Simulated streamflow in 2 scenarios without and with reservoirs



REFERENCE: Du, T. L. T. et al (2022). Streamflow Prediction in Highly Regulated, Transboundary Watersheds Using Multi-Basin Modeling and Remote Sensing Imagery. Water Resources Research, 58(3)

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