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HISTORICAL FLOOD SIMULATION AND EVALUATION THE PERFORMANCE OF GRIDDED PRECIPITATION DATASET IN PREK THNOT RIVER BASIN

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ABSTRACT

Introduction and Objective

Cambodia's Prek Thnot River is one of the Mekong's major tributaries, which flows across four provinces, including Kampong Speu, Takeo, Kandal, and Phnom Penh, before reaching the Tonle Bassac River. Since the basin has become increasingly vulnerable to dangers and calamities (IRD, 2018), particularly droughts and floods, the watershed is at risk of losing its ecological function. Because of the continuous deforestation and more rainfall received upstream, flooding can occur downstream at any moment. The most challenging aspect of enhanced flood risk management is reducing the consequences while retaining the benefits from the floods. However, the study of inundation modeling is still limited in river basins.

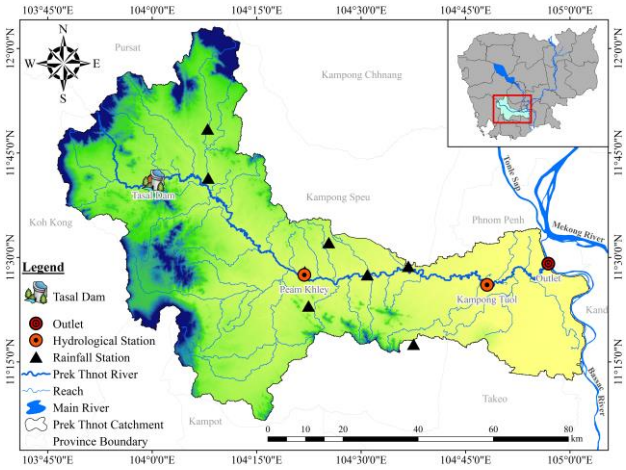

Fig. 1 Location of Prek Thnot River Basin

The purpose of this study aims to evaluate historical flood simulation and the performance of gridded precipitation datasets in the Prek Thnot River Basin.

Method

In this study, a fully distributed Rainfall-Runoff Inundation (RRI) model, developed by Sayama, Tatebe, Iwami, Tanaka, and Sciences (2015), was used to simulate historical flood hazards. The RRI model was set up using MERIT-DEM with a spatial resolution of 540 meters for river discharge and flood inundation simulations in the Prek Thnot River Basin. The study of historical flood simulation was focused mainly in 2010 from September to November. The calibration of the RRI model took place in 2010, and the validation was in 2000, 2001, and 2020. To evaluate the performance of streamflow simulation, four statistical indicators, including NSE, PBIAS, RSR, and R^2, were utilized.

Furthermore, ground rain gauge and five different gridded precipitation datasets, including APHRODITE, GPCC, PERSIANN, GSMaP, and TRMM, were used for the rainfall comparison in terms of performance for the whole Prek Thnot River Basin. Since gridded precipitation datasets came with different periods, both rain gauge data and gridded precipitation datasets were arranged for 12 years, from 2000 to 2011.

Result and Discussion

After the model verification, the simulation of 2000, 2001, 2010 and 2020 flood events resulted an overall of good performance with NSE of 0.55, 0.78, 0.64, and 0.70; PBIAS of 8.34, 1.01, -2.26, and -13.75; RSR of 0.67, 0.47, 0.60, and 0.55; and R^2 of 0.57, 0.79, 0.76, and 0.76. Moreover, the potentially flooded areas based on water depths shows in Fig. 2. The water depths could reach as high as 4 meters in 2000, 2 meters in 2001, and 3 meters in 2010 and 2020. Among the four flood events, flooded areas during 2000 were the largest, occupying more than 514.77 km^2 (9.23%). The flood events in 2010, 2001, and 2020 occupy 298.89 km^2 (5.35%) and 357.03 km^2 (6.41%), and 277.48 km^2 (4.98%), respectively. Fig. 3 shows the hydrograph and the scatter plot between APHRODITE (best-fit) dataset and the rain gauge. The figure demonstrated that the dataset and rain gauge have a strong correlation, with the coefficient of determination (R^2) of 0.6956.

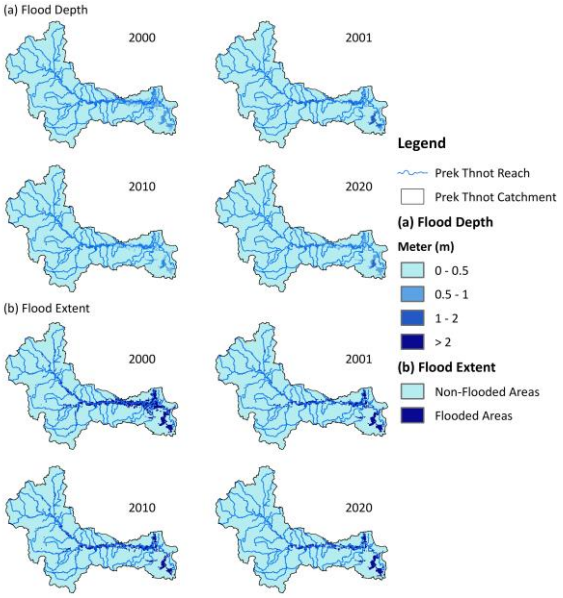

Fig. 2 Flood Depth and Flood Extent map over the Prek Thnot River Basin in 2000, 2001, 2010, and 2020

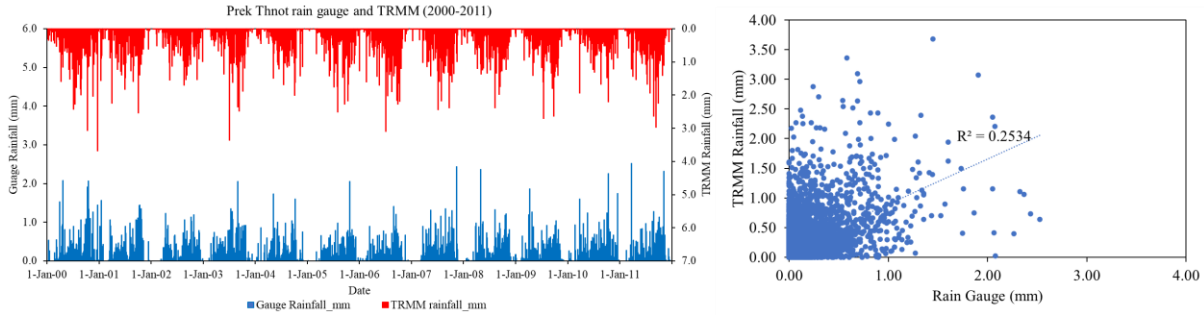

Fig. 3 Hydrograph and Scatter plot between APHRODITE dataset and rain gauge from 2000 to 2011

Conclusions

In conclusion, the results between the observed and simulated discharges based on graphical and statistical methods indicated an agreement of satisfactory in 2000, very good in 2001, and good in 2010 and 2020. The simulation also identified the flood inundation pattern, which occurred downstream of the river basin. Moreover, among the gridded precipitation datasets, APHRODITE was the best-fit dataset compared to the rain gauge.

Acknowledgement

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References

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