Improving Flood Management through Future Reservoir Development and Operation in the Tonle Sap Largest Tributary

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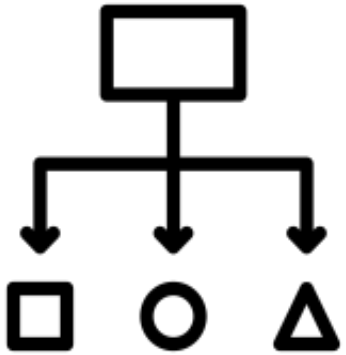
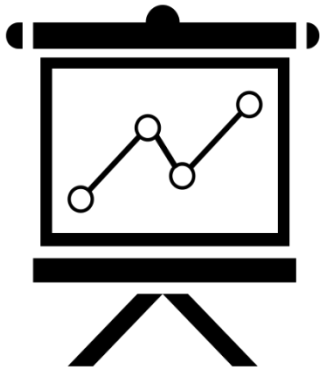
Contents

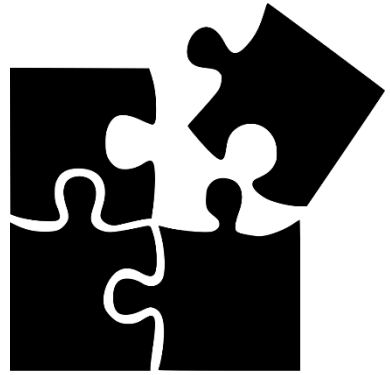
Introduction



Materials
and Methods



Results and
Discussion



Conclusion

1. Introduction

Context

- Flood is one of the frightening disasters for communities as well as societies. The potential of flood damage is likely to grow in numerous rivers arising from social and economic development.
- Obviously, Cambodia is considered as a water-rich country, which receives too much water during the rainy season that results in flooding. Hence, an effective flood risk management is needed to reduce the potential losses and damage.
- In respect to these issues, the water resources infrastructure development such as reservoir shall be addressed.

Objectives

Due to these issues, this study aims to:

(1) assess the variation of peak flow due to ongoing and future dam development and operation.

(2) investigate the flow reduction due to reservoir operation during the years of extreme flood events.

2. Materials and Methods

Study Area

- Stung Sen catchment is the largest sub-basin of Tonle Sap Lake.
- This basin partly covered two provinces, Preah Vihear and Kampong Thom and lies into the boundary of Siem Reap province.

Basin Information:

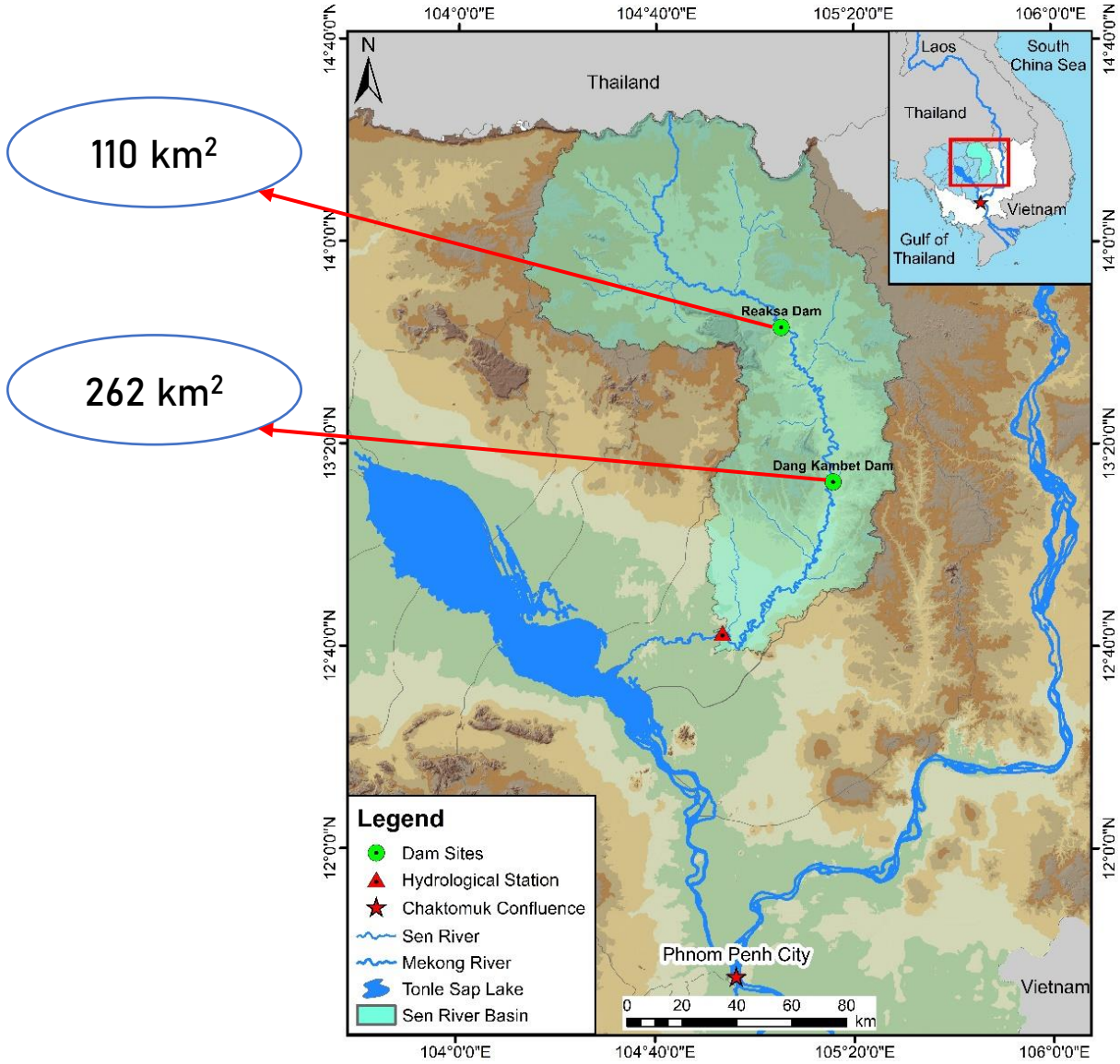
Area: about 16,000 km^2

Length: around 500 km

Mean Annual Precipitation: 1500 mm

Average temperature: 27.5°C

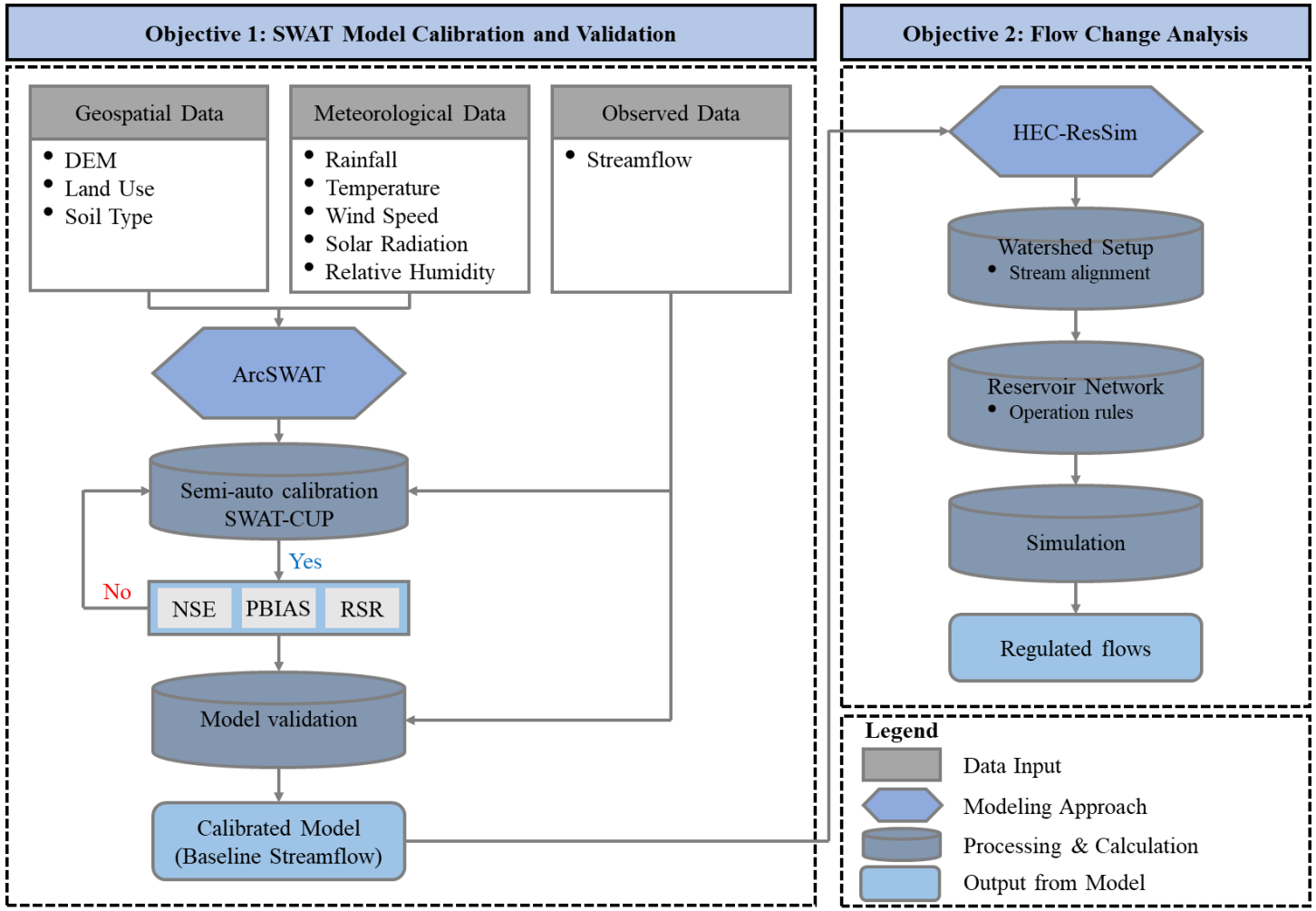
Mean flow: 249 m^3/s



2. Materials and Methods

Models Integration

- To obtain above objectives, the combination of SWAT and HEC-ResSim is conducted.
- SWAT model is used to simulate flows at the dam sites.
- Simulated flows from SWAT model is then utilized as inputs to the HEC-ResSim model for reservoir simulation.
- Within the HEC-ResSim model, the regulated flows for different operation rules can be simulated through the reservoir configurations.



2. Materials and Methods

Simulated Scenarios

A baseline, definite future, and indefinite future scenarios are simulated to access the degree of changes of

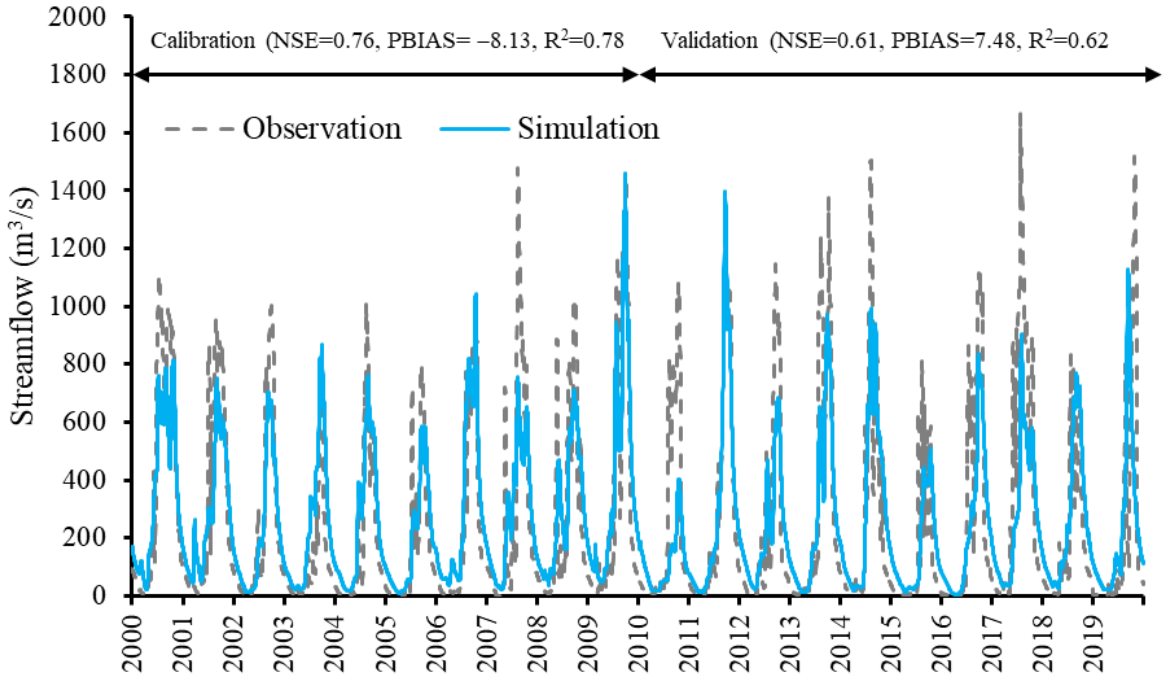
(1) Baseline scenario: reference river flow scenarios resembling natural conditions.

(2) Definite scenario: ongoing dam construction project which is going to be finished in 2022.

(3) Indefinite future scenario: ongoing dam construction and dam under planning projects that are expected to occur in the near term.

3. Results and Discussion

Streamflow model performance



Period	Statistical performance measures					
	NSE	Performance Evaluation	PBIAS	Performance Evaluation	R^2	Performance Evaluation
Calibration (2000-2009)	0.76	Good	-8.13	Good	0.78	Good
Validation (2010-2019)	0.61	Satisfactory	7.48	Good	0.62	Satisfactory

3. Results and Discussion

- Change in seven-day mean annual flow

Location	Flow	7-day mean annual (m^3/s)		
		Baseline	Definite Future	Indefinite Future
Reaksa dam site	Low	8	10	10
	High	547	200	200
Dang Kambet dam site	Low	14	18	18
	High	728	451	390
Stung Sen Town	Low	24	29	28
	High	838	633	610

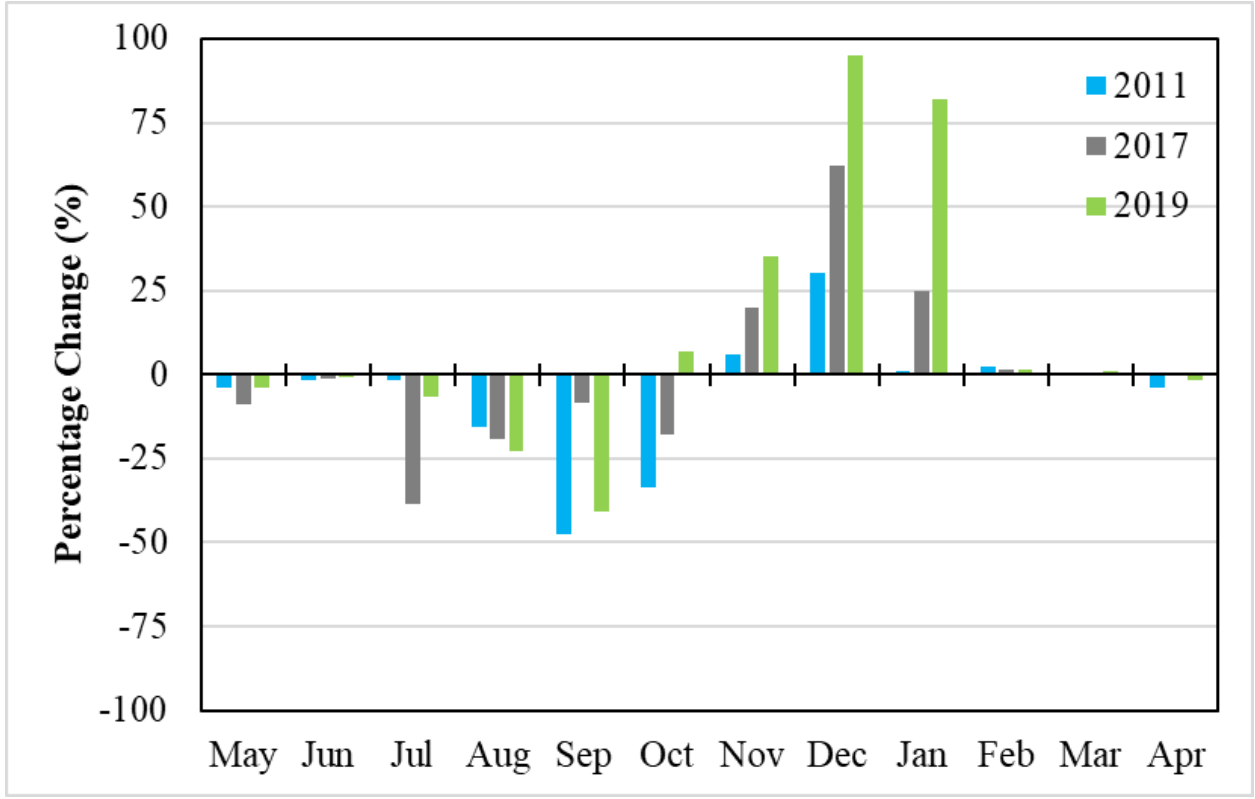
3. Results and Discussion

- Flow reduction for the years of extreme flood events

Changes in discharge

Month	2011 (m^3/s)	2017 (m^3/s)	2019 (m^3/s)
May	-2.2	-7.6	-1.6
Jun	-2.1	-2.5	-0.8
Jul	-2.9	-183.4	-8.4
Aug	-57.7	-133.7	-85
Sep	-502.6	-42	-399.3
Oct	-325.2	-94.7	34.9
Nov	32.5	66.7	89.7
Dec	85.0	118.7	136.5
Jan	0.8	34.5	73.6
Feb	0.8	1.1	0.8
Mar	0.1	0	0.3
Apr	-0.7	0	-0.3

Changes in percentage



4. Conclusion

- Modeling of medium-scale dam development and operations is possible through a combination of hydrological and reservoir operation models.
- The development of dams in the mainstream will significantly alter the flow regimes at the downstream regions.
- The 7-day mean annual high flow will reduce approximately 25% at the downstream area compared to baseline if the water in dam is kept at 40% of the full water level before receiving heavy rainfall.

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