Science of the Total Environment 630 (2018) 718–727

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

# Combined top-down and bottom-up climate change impact assessment for the hydrological system in the Vu Gia- Thu Bon River Basin

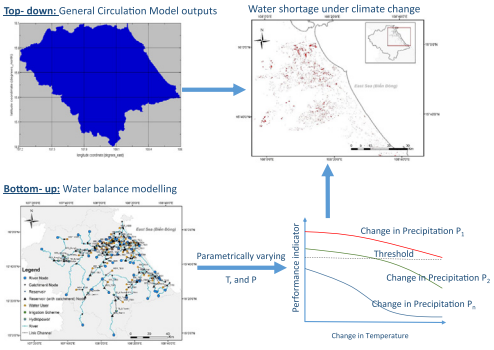
Tran Van Tra [a,b,*], Nguyen Xuan Thinh [b], Stefan Greiving [b]

[a] Viet Nam Institute of Meteorology, Hydrology and Climate Change, Viet Nam
[b] Faculty of Spatial Planning, TU Dortmund University, Germany

## HIGHLIGHTS

- Combined top-down and bottom-up assessment in the Vu Gia- Thu Bon River Basin
- Water shortage expected to worsen due to climate change
- 8777 ha of crop was determined to be at risk due to water shortage in the future.
- Shortage of water between 11.8 million $m^3$ and 20.9 million $m^3$ expected

## GRAPHICAL ABSTRACT




## ARTICLE INFO

*Article history:*
Received 12 October 2017
Received in revised form 20 February 2018
Accepted 20 February 2018
Available online xxxx

*Keywords:*
Water shortage
MIKE BASIN
Combined top-down and bottom-up

## ABSTRACT

Vu Gia- Thu Bon (VGTB) River Basin, located in the Central Coastal zone of Viet Nam currently faces water shortage. Climate change is expected to exacerbate the challenge. Therefore, there is a need to study the impacts of climate change on water shortage in the river basin. The study adopts a combined top-down and bottom-up climate change impact assessment to address the impacts of climate change on water shortage in the VGTB River Basin. A MIKE BASIN water balance model for the river basin was established to simulate the response of the hydrological system. Simulations were performed through parametrically varying temperature and precipitation to determine the vulnerability space of water shortage. General Circulation Models (GCMs) were then utilized to provide climate projections for the river basin. The output from GCMs was then mapped onto the vulnerability space determined earlier. In total, 9 out of 55 water demand nodes in the simulation are expected to face problematic conditions as future climate changes.



## 1. Introduction

Vu Gia- Thu Bon (VGTB) River Basin, located in the Central Coastal zone of Viet Nam, currently faces water shortages. Rainfall in the river basin is temporally variable with a prolonged dry season. The dry season in the river basin spans 8 months within the year and contributes approximately 30% towards total annual precipitation. Prolonged dry conditions with limited rainfall create a huge challenge for water supply in the river basin. As water resources will be the principal medium climate change impacts are felt (García et al., 2014), the challenges of water management in the VGTB River Basin is likely to be exacerbated in the future.

There have been extensive studies into ways climate change impacts the water systems in general and in the VGTB in particular. Traditionally a top-down scheme is applied. While this approach produce optimal

* Corresponding author at: Viet Nam Institute of Meteorology, Hydrology and Climate Change, Viet Nam.
*E-mail address:* tvtra@monre.gov.vn (T.V. Tra).

https://doi.org/10.1016/j.scitotenv.2018.02.250
0048-9697/

results for the intended future, its usability remains relatively limited in terms of decision support and policy design due to the uncertainties of climate change (Brown et al., 2012; Hallegatte et al., 2012). Uncertainties in climate projection often come in the form of various climate change scenarios. Variability from different projections can be large and to plan for one projection could strictly be contradictory to the other (Brown, 2011). Furthermore, the process of downscaling outputs from GCMs, and predicting socio-economic changes in the future entails large uncertainties. This creates a gap in translating climate information into adaptation policy (Dilling and Lemos, 2011).

For this reason, this study seeks to adopt a different approach with less reliance on the use of GCMs and to omit the use of GCMs downscaling in climate change adaptation for the VGTB River Basin. This is achieved through adopting the decision scaling framework. The result of the study includes better-tailored and more relevant climate change information that are useful for adaptation measures.

## 2. Study area

The VGTB River Basin is located in the Central Coastal Zone of Vietnam. The total catchment area of the river basin is approximately 10,350 km$^2$ and is shared between Da Nang City and Quang Nam Province in Vietnam (Fig. 1). Total population in the river basin is approximately 2 million inhabitants including those living in Da Nang City

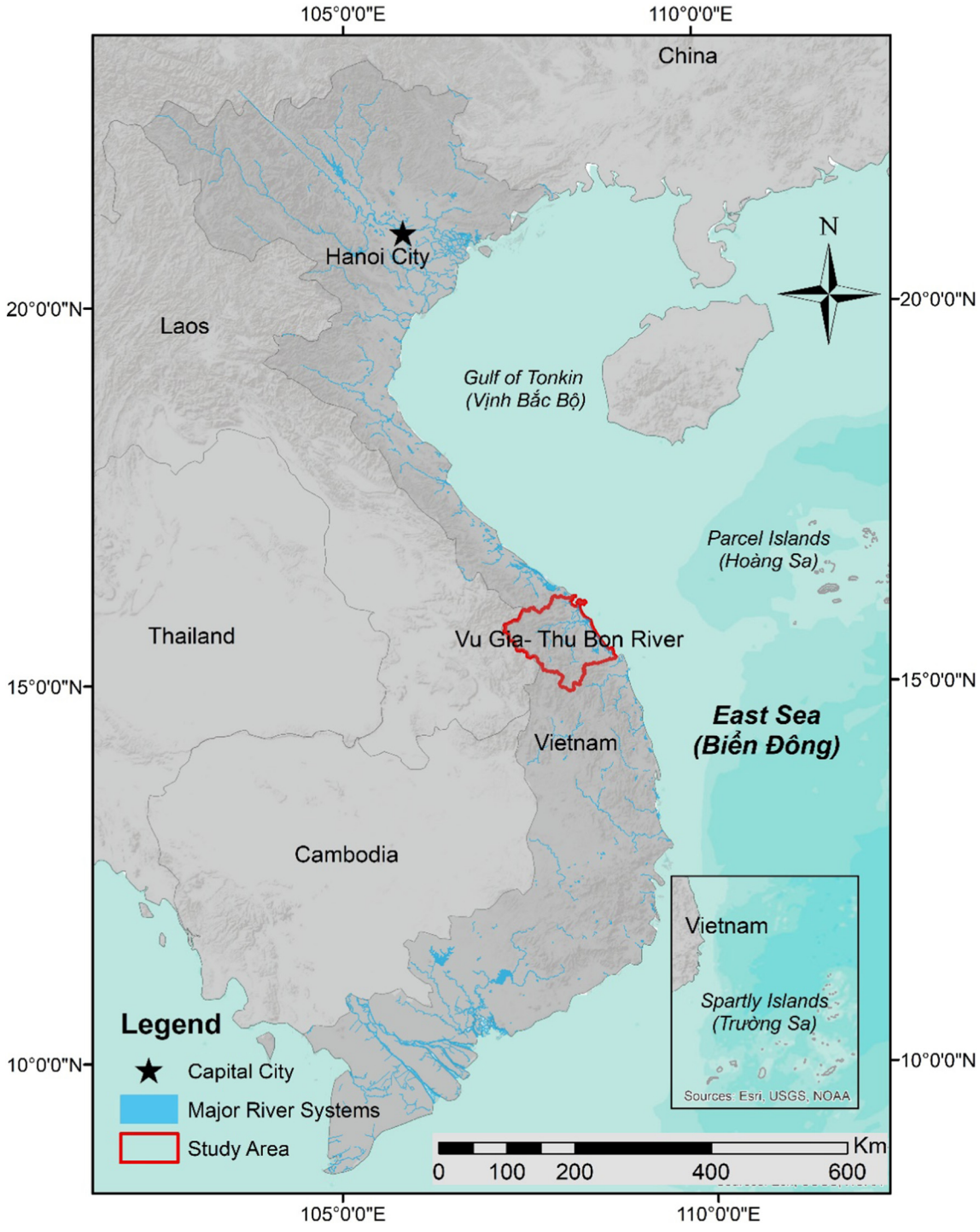



**Fig. 1.** Location of the study area.