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Assessment on Hydrologic Response by Climate Change in the Chao Phraya River Basin, Thailand

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Abstract: The Chao Phraya River in Thailand has been greatly affected by climate change and the occurrence of extreme flood events, hindering its economic development. This study assessed the hydrological responses of the Chao Phraya River basin under several climate sensitivity and greenhouse gas emission scenarios. The Soil and Water Assessment Tool (SWAT) model was applied to simulate the streamflow using meteorological and observed data over a nine-year period from 2003 to 2011. The SWAT model produced an acceptable performance for calibration and validation, yielding Nash-Sutcliffe efficiency (NSE) values greater than 0.5. Precipitation scenarios yielded streamflow variations that corresponded to the change of rainfall intensity and amount of rainfall, while scenarios with increased air temperatures predicted future water shortages. High CO_2 concentration scenarios incorporated plant responses that led to a dramatic increase in streamflow. The greenhouse gas emission scenarios increased the streamflow variations to 6.8%, 41.9%, and 38.4% from the reference period (2003–2011). This study also provided a framework upon which the peak flow can be managed to control the nonpoint sources during wet season. We hope that the future climate scenarios presented in this study could provide predictive information for the river basin.

Keywords: hydrology; Chao Phraya; SWAT

1. Introduction

Current environmental changes due to either natural or anthropogenic influences are creating a significant impact on natural resources and the living conditions of humans [1]. In particular, as a critical natural resource, water bodies have been subjected to pollution and are reaching scarcity levels around the globe [2,3]. Climate change is a key factor that has greatly affected water resources, due to its uncertainty and variability [4–6]; the intensities and frequencies of rainfall have been fluctuating over the years, thereby changing the spatiotemporal distributions of water resources [7]. Furthermore, it is apparent that climate change influences a change in water quality by modifying