Assessment of future climate change impacts on streamflow and groundwater by hydrological modeling in the Choushui River Alluvial Fan, Taiwan

Presenter : Thi-My-Linh Ngo
Advisor : Prof. Shih-Jung Wang
Co-advisor : Prof Pei-Yuan Chen
Date : 2022/10/07

Abstract

The diverse impacts of climate change on agro-ecosystems require comprehensive modeling capabilities to simulate water interactions between surface water (SW) and groundwater (GW). The objectives of this study were to apply the coupled SWAT-MODFLOW models, which include the Soil Water Assessment Tool (SWAT) and Modular Three-Dimensional Finite-Difference Groundwater Flow (MODFLOW-NWT), to estimate streamflow discharge, GW recharge, and water exchange between GW and SW in the Choushui River Alluvial Fan, Taiwan. The research assesses the impact of climate change scenarios influence on GW recharge in the future. The finest practical spatiotemporal resolutions of five kilometres during 100 years were selected to accommodate the future climatic conditions of catchment features provided by TCCIP. Confidence in the calibrated model was enhanced by validation through generally good statistical performance for the temporal pattern of streamflow and GW level, with the Nash–Sutcliffe model efficiency coefficients, R^2, percent bias, root mean squared error, and mean absolute error, respectively, which helps achieve a reliable simulation of the watershed response. The calibration and validation of the SWAT-MODFLOW demonstrated that the developed model successfully simulated GW head for the study area as well as streamflow discharge in the Choushui and Peikang rivers. The spatiotemporal variability of GW recharge for 2005-2100 was estimated under the baseline and four representative concentration pathways (RCPs) scenarios. The recharge mainly occurs in the top fan area, catching up some potential high recharge locations with previously delineated sensitive areas for GW recharge by Central Geological Survey, Taiwan. The climate change signal predominates the annual variability, resulting in a more pronounced pattern of greater recharge concentrated in fewer years. The well-tested coupled model would be a

valuable tool for evaluating a wide variety of realistic scenarios in order to determine the most efficient and workable water resource management plans for replenishing the critically depleted SW and GW supplies. These findings help decision-makers and stakeholders devise sustainable water resource strategies.

Keywords: hydrological modeling, climate change, streamflow, GW, SWAT-MODFLOW.