AGU Fall Meeting Abstracts
H32E-07, 2017
AGU Fall Meeting 2017

Simulation of future land use change and climate change impacts on hydrological processes in a tropical catchment

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Future hydrological processes in the Samin catchment (278 km^2) in Java, Indonesia have been simulated using the Soil and Water Assessment Tool (SWAT) model using inputs from predicted land use distributions in the period 2030-2050, bias corrected Regional Climate Model (RCM) output and output of six Global Climate Models (GCMs) to include climate model uncertainty. Two land use change scenarios namely a business-as-usual (BAU) scenario, where no measures are taken to control land use change, and a controlled (CON) scenario, where the future land use follows the land use planning, were used in the simulations together with two climate change scenarios namely Representative Concentration Pathway (RCP) 4.5 and 8.5. It was predicted that in 2050 settlement and agriculture area of the study catchment will increase by 33.9% and 3.5%, respectively under the BAU scenario, whereas agriculture area and evergreen forest will increase by 15.2% and 10.2%, respectively under the CON scenario. In comparison to the baseline conditions (1983 –2005), the predicted mean annual maximum and minimum temperature in 2030 – 2050 will increase by an average of +1 °C, while changes in the mean annual rainfall range from -20% to +19% under RCP 4.5 and from -25% to +15% under RCP 8.5. The results show that land use change and climate change individually will cause changes in the water balance components, but that more pronounced changes are expected if the drivers are combined, in particular for changes in annual stream flow and surface runoff. It was observed that combination of the RCP 4.5 climate scenario and BAU land use scenario resulted in an increase of the mean annual stream flow from -7% to +64% and surface runoff from +21% to +102%, which is 40% and 60% more than when land use change is acting alone. Furthermore, under the CON scenario the annual stream flow and surface runoff could be potentially reduced by up to 10% and 30%, respectively indicating the effectiveness of applied land use planning. The findings of this study will be useful for the water resource managers to mitigate future risks associated with land use and climate changes in the study catchment.