Application of the SWAT Model in the Ghare Sou river Basin under climate change

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Introduction

In this study, Soil and Water Assessment Tool (SWAT) was used to evaluate the effects of climate change on river flow in the Ghare sou watershed. Karkheh Basin is located in the west of Iran with area of 50764 km^2. It is located in the middle parts and southwest regions of Zagros Mountains between 46° 06′ and 49° 10′ of east longitude also between 30° 58′ and 34° 56′ north longitude. Ghare Sou is a sub basin of Karkheh in northwestern of Karkheh basin and west of Iran. Its area is 5354 km^2 with a maximum and minimum height of the 3346m and 1180 m respectively. Average of annual rainfall varies between 300mm to 800 mm.

At present, various methods for generating climate scenarios are used for future periods. These methods include: producing synthetic scenarios, using past climate parameters and using Atmosphere Ocean General Circulation Model (AOGCM).

Current most reliable tools for producing climate scenarios are three dimensional coupled models of ocean-atmosphere general circulation (Wilby and Harris 2006, Mitchell 2003). AOGCM models are based on physical laws and mathematical relationships. These relationships solve in a three dimensional network of the earth surface. AOGMCM is a valid tool for predicting climate change and producing hydrological model inputs. Recently, some studies have been done about effects of climate change on runoff. These studies combined the outputs of general circulation models and hydrological models. Predictions by AOGCM is the first attempt to assess the effect of climate change on hydrology at the basin scale.

Results and discussion

To assess water balance of the basin SWAT model was used. Physical-based and distributed parameters were developed to prediction of land use changes and management practices in the large and complicated basins

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(Verbeeten and Barendregt, 2007).

SWAT model was developed to predict the effects of land management activities on water, sedimentation and chemical-agricultural agents with a variety of soil, land cover and management conditions in the large-term period. This model is a physical model. This model uses specific information about air, soil, topography, vegetation and land cover in the basin instead of using the equations to describe the relationships between input and output.

Sub basins are divided to hydrological response parts (HRUs). Several parameters for model calibration have been selected. All parameters considering the river flow calibration have been adjusted by using of hydrometric station data of Ghara Baghestan. These parameters were selected according to previous researches in the field of calibration of SWAT model (Kati et al., 2005).

Model calibration has been done with correlation function value, simulation of monthly flow, Nush-Sutcliffe (E_{ns}), average of monthly flow and variance of monthly flow between 1992-1996. Model assessment have been carried out between 1998-2000

Considering pronounced effect of temperature and precipitation variables on the water resource systems, agriculture, environment and etc., basic studies on the climate change effects is mainly on these two variables.

As it can be seen, average of long-term monthly temperature increase in the period of 204-2069 the increasing of average annual is 2.6°C, maximum decrease is 4.5 °C in June and minimum decrease is 1°C in December.

In season comparison, summer has maximum increasing in the temperature than other seasons. This increasing is 4°C, while average of winter temperature increase is 1°C.

Conclusion

In this study the effect of climate change on the outflow of Ghare Sou basin in the period of 2040-2069 with HadCM3 model, one of the AOGCM model under A2 Scenario, has been analyzed. Continuous simulation model of runoff was applied to study hydrology of the basin under climate change conditions.

The results of temperature and precipitation scenarios of HadCM3, from forth IPCC report, and simulated time series model with SWAT (rainfall-runoff model) showed that climate and hydrological parameters of Ghare sou have significant changes in the future.

Key words: Climate Change, SWAT, HadCM3, Ghare sou