Shahid Chamran University of Ahvaz

Irrigation Sciences and Engineering **Vol. 41, No. 3, Fall 2018, p. 103-117**

EXTENDED ABSTRACT

Investigating the Effect of Climate Change on River Flow Using IHACRES Rainfall-Runoff Model

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Received:25 September 2016 Accepted: 19 February 2017

Keywords: Climate Change, Hydrological Models, Scenario, LARS-WG Model, IHACRES Model.

Introduction

Since the importance of water in the durability and survival of life is clear to everyone, water issue has always been the focus of researchers and experts. Iran, having its own geographical and climatic location, has a small share of rainfall. Therefore, having an average annual rainfall of about 240 millimeters, one-third of the global average (860 millimeters), it is part of the dry and semi-arid climate (Alizadeh, 1997). Due to the lack of statistics, complexity of hydrological ecosystems and the impossibility of full recognition of the conditions in many catchment areas of the country, the use of methods that measure the amount of runoff from rainfall in non-statistical basins or those with incomplete statistics are of prime importance. One of these methods is the use of the capabilities of hydrological models in the simulation of hydrological processes which is one of the initial stages of water resources management and planning, and also the study of the hydrological effects of land use change and the way of exploitation of natural resources in a basin, where it is possible to simulate the hydrological processes, such as runoff, in the basins with complete statistics with the lowest cost and minimum time, and then use the information to estimate runoff in similar basins with no statistical data or incomplete statistics (Namdorost, 2002). LARS-WG5 is one of the generators of meteorological accidental data that is used to generate daily rainfall data, daily irradiance and maximum and minimum daily temperatures in a station under present and future climate conditions (Semenov and .Brooks., 1998). Zarghami et al (2001) reported a 2.3 degree increase in temperature and a 3 percent reduction in rainfall over the years 2020-2090 for East Azarbaijan province with the LRS-WG Exponential Meteorological Scale under the A1B, A2 and B1 scenarios using HADCM3 output.

Materials and methods:

In this study, the Mohammad Abad basin was selected. This basin is a sub-basin of the Gorgan Rood catchment area in Golestan province. The basin has an area of 387.5 square kilometers and is 89 kilometers in circumference. It is geographically located in 54º 49′ 55″ Eastern longitude and 36º

42′ 34″ Northern latitude. Maximum and minimum height of the basin is 3500 and 500 meters, respectively; with an average height of 1906 meters and a mean slope of 10.3 percent. In this research, the IHACRES rainfall-runoff model was first calibrated for the Mohammad Abad basin. Then, based on the output results of the HadCM3 model under A1B, A2 and B1 scenarios, temperature and precipitation values for the next period of 2040-2011 were estimated using the LARS-WG model and an IHACRES model was introduced to simulate the runoff for the basin.

LARS-WG5 is one of the generators of meteorological data on a daily basis, using which the GCM model outputs daily rainfall data and maximum and minimum temperatures at the desired station. The model is a numerical model that disperses the output of the general atmospheric circulation model using statistical methods, which is very similar to the actual value on the station scale. The IHACRES Rainfall-Runoff Model has been developed jointly by the ICAM's National Center for Management and Comprehensive Assessment (ICAM) of the Australian National University, Canberra and the Ecology and Hydrology Center (CEH) of the UK Environmental Research Society. This model consists of two nonlinear and linear interconnected segments that are defined for calculation of losses and effective rainfall conversion to runoff, respectively.

Results and Discussion

After calibration of the model, the monthly runoff run time series for the period 2040-2011 was simulated for the temperature and rainfall samples produced by the LARS-WG model for all three A1B, A2 and B1 scenarios using the IHACRES model. Then, the long term average monthly runoff (30 years) in the future period was investigated with the average monthly runoff of the observation period in all three scenarios. The results showed that the long term average annual runoff during the period 2040-2011 will reduce 165.64 cms in scenario A1B, 231.88 cms in A2, and 126.18 cms in B1 compared to the period 2010-2018.

Conclusion

In this research, the effect of climate change on the runoff of the Mohammad Abad basin in Golestan province during the period of 2040-2011 was analyzed by the LARS-WG climatic model and three scenarios of A1B, A2, and B1 of general circulation model HADCM3. The results showed that the temperature of the basin will increase over the period from 2040-2011 for all three scenarios. It is observed that monthly rainfall has increased in all three scenarios in December. In both scenarios A1B and B1 in July and scenario A2 in August, there is a decrease in monthly rainfall compared to the observation period. Finally, the highest rainfall, under the scenario B1, in December, is 0.82 mm and the highest decrease of the monthly rainfall, under scenario A2, is 0.38 in August. On the other hand, the highest runoff rate under B1 scenario in December is 1.21 cms and the highest runoff under A2 scenario in May is 0.82cms. The results obtained from this study in the rainfall section is in agreement with the research (Mehdizadeh et al., 2011), in the Golestan Dam basin, which were coducted using the CGCM3 model for the years 2050-2021 under two A2 and B1 scenarios, and generally, the results showed that monthly average rainfall decreases in summer and spring seasons and increases in winter and autumn seasons. Also, based on Mahdi-Zadeh's research, in Karim-e-Yashan station with wet climate rainfall, changes will more intensely occur in A2 scenario. But in this research, which uses three scenarios, in the moderate climate of Sarmo station, the maximum rainfall variation under scenario B1 will be expected in autumn and early winter and late summer.

Finally, the results showed that the average annual long term runoff variation in the period 2040-2011 will decrease 1.72 m^3/ s in A1B scenario, 4.86 m^3 / s in A2 scenario, and 0.25 m^3 / s in B1 scenario compared to the 1982-2010 period.

References

1- Alizadeh, A.,1997.*Principles of Applied Hydrology*, Ninth Edition, Astan Quds Razavi Publishing Center. Ferdowsi University of Mashhad (In Persian).

2- Namdorost, J.,2002.Simulation of the effect of hydrological parameters on runoff runoff in some watersheds of Iran. Thesis Master. Watershed group. Faculty of Natural Resources and Naval Sciences. Tarbiat Modares University. P 44(In Persian).

3- Semenov, M.A. and Brooks, R.J. 1998. Comparison of the WGEN and LARS-WG stochastic weather generators for diverse climates. *Climate Research*,10, pp95-107.

4- Zarghami, M., abdi, A., Babaeian, E., Hasanzadeh, Y. and Kanani, R.,2011.Effects of Climate Change in the Channels in the East of the Republic of Azerbaijan. *In the Iranian press, Worldwide and Planetary Change, available online on June 30, 2011*, pp. 30-6. (In Persian).