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Investigating the Effect of Climate Change on the Runoff Resulting from Snowmelt in Gamasiab Basin

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1-Introduction

Determining the temporal change of snowmelt or agriculture water equivalent of snow, predicting flood, and managing the reservoirs of a region is of utmost importance. Some major parts of the western sections of the country are located in the mountainous region and most of the precipitations of this region occur in the form of snow in winter. The runoff resulting from snowmelt has an important role in feeding the rivers of this region and it has a significant share in developing agriculture and the economy.

Scientific studies have shown that climate change phenomena have significant effects on precipitations, evaporation, perspiration, runoff, and finally water supply. As the demand increases, climate changes, greatness, frequency, and the damage resulting from extreme weather events, as well as the costs of having access to water increase, as well. Therefore, evaluating the runoff resulting from snowmelt and the effect of climate change seems necessary for managing water resources.

2-Methodology

Gamasiab basin is located in the northeast part of the Karkheh basin originating from the springs in the vicinity of Nahavand. Its basin has an area almost equal to 11040 square kilometers that have been located in the east part having 47 degrees and 7 minutes to 49 degrees and 10 minutes geographical longitude and from the north part, it has 33 degrees and 48 minutes to 34 degrees and 54 minutes geographical latitude. This basin has an altitude between 1275 to 3680 meters.

In this study, snow-related data required for simulation were derived from the daily images of the MODIS sensor. To this end, first, the snow-covered area of the Gamasiab basin was measured during the 2016-2017 water years using the process of satellite images obtained from the MODIS sensor in the google earth engine system. All

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geometric justifications and calibration processes of images were applied precisely in the mentioned system. In the next step, the output of the GCM model scenarios was utilized for calculating temperature and precipitation changes in future periods. These CMIP5 kind models were under the control of two RCP45 and RCP85 scenarios and were downscaled with LARS-WG statistical model.

Moreover, to investigate the uncertainty of models and scenarios, the best models and scenarios were selected for producing temperature and precipitation data of future periods; accordingly, the outputs of the models for future periods (2021-2040) having the basis period of (1980-2010) were compared using statistical indexes of coefficient of determination (R2) and Root Mean Square Error (RMSE). The results were entered into the SRM model as the inputs. In addition, temperature and precipitation data of meteorological station of the studied region as well as the daily discharge of the river flow of hydrometric station of Chehr Bridge (as located in the output part of Gamasiab basin) were used during the statistical period of October 2016 to May 2018.

3-Results and Discussion

Using Digital Elevation Model (DEM) of the region and the appendage of Hec-GeoHMS in GIS software, firstly, flow direction map, flow accumulation map, and stream maps were drawn and the output point (hydrometric station of Chehr Bridge) was introduced to the border program of the identified basin and the basin was classified based on the three elevation regions.

Producing temperature and precipitation data of future periods requires a long-term statistical period; accordingly, the meteorological station of Kermanshahd was selected since it was in the vicinity of the studied region. To be confident in the ability of the model in producing data in future periods, the calculated data had to be compared with the observed model and data in the studied stations. The capabilities of the LARS-WG model in modeling the mentioned parameters of this station confirmed the observed data. Moreover, the ability of the model in modeling precipitation was very good and acceptable; however, the most modeling error was related to the precipitation in Mars.

In the next phase and compared to the basic periods, the mean of changes in average precipitation and temperature was measured in the studied stations during January and Juan of 2015 to 2017(for which simulation had occurred); as an index of changing the climate, this was entered into the SRM model under climate change conditions. During the simulation period (January to Juan), it had been predicted that the precipitation parameter would decrease and the temperature parameter would increase.

4-Conclusion

The results of this study indicated that using the MODIS sensor could provide an acceptable estimation of the snow cover level of the Gamasiab basin, which lacked snow gauge data. Moreover, the results of simulation with the SRM model showed that the model could simulate the snow runoff in the studied region. As the main purpose of the study, the effect of temperature and precipitation in future periods was well stated considering the uncertainty of CMP15 series models and scenarios. The results of temperature changes indicated an average increase of 1.8 C. the results of precipitation also indicated an average decrease of more than 5%. However, decreasing precipitation in the cold months of the years had been predicted severely so that the reduction of precipitation in February was of utmost importance for feeding the snow cover and rivers, which had been estimated to be 20%. This happened while increasing precipitation was mainly related to the hot months of the year whose amount was insignificant and didn`t have that much effect on the runoff. Accordingly, due to the increases in temperature and decreases in precipitation in cold seasons, the results of runoff simulation have indicated a 24% reduction for 2016-2017 and a 29% reduction for 2017-2018 water years.

Keywords: Snow, Climate change, Remote sensing, SRM, Gamasiab.

5-References

Bales R.C. and Cline D. (2003). Snow hydrology and water resources: western united states, In Handbook of Weather, Climate and Water: Dynamics, Climate, Physical Meteorology, Weather Systems, and Measurements, Ed. Potter T.D., Colman B.R., Wiley-Interscience, 10: 443-459.

Karamouz, mand Araghinezhad, sh. (2014). Advanced hydrology. Amirkabir University of Technology Publications (Tehran Polytechnic). (In Persian). Third edition.

Racsko, P. Szeidl, L and Semenov, M. A. (1991). Serial approach to local Stochastic Weather Models. *Ecological Modeling*.

Rango A. and Martinec J. (1998). The snowmelt runoff model (SRM) user′s manual, version 4, URL: fttp // hydrolab. arsusda. gov/ pub / srm / srm4.pdf.

Semenov M A and Barrow E M. (1997). Use of a stochastic weather Generator in the Development of Climate Change Scenarios. *Climate Change*.