HYDROLOGICAL RESPONSE UNDER CMIP6 CLIMATE PROJECTION OF ASTOR RIVER BASIN

by

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2018-MS-WRE-126

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2022

Centre of Excellence in Water Resources Engineering
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A THESIS

presented to the university of engineering and technology, Lahore
in partial fulfillment of the requirements for the degree of
Master of Science
in
WATER RESOURCES ENGINEERING

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Approval Date: 1/4/2022

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ABSTRACT

Availability of catchment water resources is closely linked to variations in climate. Climate change affects watersheds due to the direct influence of atmospheric driving forces and changes in watershed hydrological processes. Understanding how these climatic changes affect watershed hydrology is essential for human society and environmental processes. The latest Coupled Model Intercomparison Project phase 6 (CMIP6) dataset of three GCM's (BCC-CSM 2-MR, INM CM-5-0, and MPI ESM 1 2 HR) with high resolution (100 km) has been analyzed to examine the projected changes in temperature and precipitation over the Astor catchment during 2020-2070.

Bias correction method was used to reduce errors. In this study, statistical significance of trends was performed by using the Man- Kendall test. Sen's estimator determined the magnitude of the trend on both a seasonal (Winter, Spring, Summer, Autumn) and an annual scale at Rama Rattu and Astor stations. MPI ESM 1 2 HR showed better results with COD ranges from 0.70-0.74 for precipitation and 0.90-0.92 for maximum and minimum temperatures at Astor, Rama, and Rattu followed by INM CM 5-0 and BCC CSM 2 MR. University of British Columbia Watershed model was used to attain the future hydrological series and analyze the hydrological response to climate change in Astor River Basin.

Results revealed that by the end of the 2070s, average annual precipitation is projected to increase under the SSP 2.6, SSP 4.5, and decrease under the SSP 8.5 scenario of three GCMs. The rate of change in the precipitation varied considerably. The seasonal precipitation projections also showed considerable variability during summer and winter.

The projected temperature showed an increasing trend that caused glacier melting. The decade-wise change in temperature over Astor is projected to increase ranges -0.66 – 0.50°C, 0.9 – 1.5°C and 1.18 – 2°C under the SSP 2.6, SSP 4.5 and SSP 8.5 scenarios, respectively. Simulated streamflows for the studied period presented a slight increase in the predicted flow in the catchment for all scenarios. Maximum streamflow was generated under SSP 8.5 followed by SSP 4.5 and SSP 2.6 of selected GCMs. The streamflow contribution by snowmelt and groundwater decreased while the contribution of rainfall and glacier increased from 2020 to 2070. In the impact analysis, the projected streamflows (2020-2070) compared to the control period (1990-2014) showed a reduction of 3 - 11%, 2 - 9%, and 1 - 7% by SSP 2.6, SSP 4.5, and SSP 8.5, respectively. The results presented in this study give detailed insights into the performance of three GCMs, which could be extended further to develop adaptation strategies and may act as a guideline document for climate change-related policymaking in the region.