An Overview of Climate Changes of Temperature and Precipitation in the CORDEX Range of South Asia (Case Study: Dez Watershed)

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Extended Abstract

1. Introduction

Investigating climate changes, proposing appropriate adaptation strategies, and reducing the effects of climate changes on each region need precise and accurate predictions of climate variables. These predictions depend on the outputs of the GCM models, but the multiplicity of models, the uncertainties in the outputs, and the differences in their results confound the researchers' choices. The purpose of this paper is to evaluate the accuracy of the set of general circulation models of CORDEX base (South Asia) in simulating temperature and precipitation as influential variables in the Dez watershed.

2. Review of Literature and Theoretical Framework

Numerous studies of CORDEX project regional climate model outputs have been conducted in different parts of the world, some of which are mentioned below. The performance of 10 CORDEX regional climate models in simulating rainfall patterns in East Africa were examined. The outputs indicate the combined capabilities of these models in estimating future rainfall in this region (Endis et al., 2013). The effects of climate change on extreme precipitation over four African coastal, using 16 regional climate models, showed that the models give realistic simulation of extreme precipitation characteristics over the cities. Other results of this study are the decrease in wet days and an increase in dry wet over the four points and the increase of intensity and frequency of extreme precipitation events are increase over Lagos (Abiodun et al., 2017). Warnatzsch and Reay (2019) evaluated the ability of general circulation models (GCMs) and regional climate

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models (RCMs) to simulate climatic variables in Malawi. They simulate the trending change in temperature variables well, but the simulated outputs for precipitation are highly variabile. Kamyar, Movahedi and Yazdanpanah (2017) examined projection of minimum and maximum air temperatures in Isfahan Province during 2050-under two scenarios RCP8.5 and RCP4.5. The results indicate an increasing trend of these two parameters for both scenarios in the coming decades. The evaluation of the output accuracy of CORDEX-WAS (South Asia) and CORDEX-MNA (MENA) regional models for Iran showed that the models in CORDEX program for precipitation do not have much correlation with observational data but show high minimum and maximum correlation parameters for two temperature parameters.

3. Method

Dez River Basin is located in the semi-arid southwest region of Iran. Simulation of seventeen general circulation models was taken from CORDEX-WAS (South Asia) from the ESGF website. To perform this research, first a program in the MATLAB software was run to extract model data in the Iran area and then was compared the observational data with the model data, assuming that at a resolution of 0.44, the observation station with the corresponding cell is less than 25 km. In order to correct the bias of simulated monthly precipitation and temperature data in the historical period and then the future period in each of the stations and for all three parameters of each model, the change factor method was applied. Moreover, root mean square error (RMSE), the coefficient of correlation and the skill scores (SS) were used to evaluate the model performance.

4. Results and Discussion

Taylor diagrams showed that the simulation models have low similarity with observations for precipitation variable, maximum temperature and minimum before bias correction. The bias correction for temperature and precipitation parameters in historical period causes the increase in the correlation to 0.98 for minimum and maximum temperature and 0.65. 0 for precipitation. One of the methods that enabling the evaluation of a wide range of uncertainties in climate change studies is the ensembles method. In this study, the combination of models with different skill scores was used which reduced the errors in the models and improved the skill score. Therefore, many different combinations of 17 models were studied. Finally, it yields the selection of a 10-model set (M3 M10, M9, M4, M14, M6, M12, M2, M11, M7) with high skill scores (SS). Simulation of temperature and precipitation climatic parameters for future periods in Dez basin was done for three 20-year periods (2070-2070, 2050-2050 and 2020-2039) under two scenarios RCP4.5 and RCP8.5. The results of the selected models uncovered an 11 to 17 % decrease in precipitation rate for the RCP4.5 scenario, and 8 to 18 % for the RCP8.5 scenario for the whole basin. The output of the basin's maximum temperature for the RCP4.5 emission scenario is projected to increase by 1.5 to 3 °C and for the pessimistic scenario RCP8.5 predicts an increase of 5.8 to 1.6 °C. This increase for the minimum temperature for the RCP4.5 and RCP8.5 emission scenarios is between 1.5 to 4.2 and 2.7 to 5.3 °C, respectively. Then, the basin was divided into three altitudes based on topographic features with topographies of flatland, foothill, and mountain. One station was selected as representative for each floor, and annual and monthly climate change parameters of the selected stations were examined for next decades. Investigations for selected stations in the three different topographic ranges of the basin also showed that maximum and minimum temperatures indices will increase under both scenarios. Although precipitation forecasting has been associated with anomalies, the common theme in the study topographic ranges increased in autumn precipitation.

5. Conclusion

In this study, the performance of 17 general circulation barley models from CORDEX-WAS (South Asia) in predicting temperature and precipitation of Dez basin was evaluated. The results showed that the simulations of the models are false and need to be corrected in the studies before using them. Since selecting a model for climate change analysis cannot cover the whole range of uncertainties, a set of 10 was selected to lead to a more accurate prediction of climate change. The results indicated that this basin will move towards a climate with lower humidity and higher temperature in the coming decades. According to the results of this study, it seems that CORDEX databases have an acceptable ability to predict the temperature and precipitation of similar study areas. Since the mentioned basin is one of the rainy areas and on the other hand the precipitation parameter has a higher coefficient of variability than the temperature, the selected models in the research may not give acceptable results in basins with less rainfall or drier climatic zones. It is suggested that researchers compare different bias correction methods such as cumulative distribution function, probability distribution function, or transfer function to achieve the desired results and select the most appropriate method for their study area.

Keywords: Climate Change, Bias Correction, Skill Score (SS), Dez basin, CORDEX Climate Models

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