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Assessing the Impact of Future Climate Change on Precipitation and Temperature Meteorological Parameters: A Case Study of Bandar Abbas

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Extended Abstract

Introduction: The worldwide climate researches have generated large-scale models and shared their results to increase the accuracy of various models in working with big datasets. Among the various statistical approaches, empirical downscaling methods are the most commonly used ones due to their ease of implementation. Several empirical downscaling approaches have been proposed which need to be assessed as to which method contributes (or not) to the overall climate change uncertainty. Therefore, this research sought to investigate the effects of climate variation on temperature and precipitation in different seasons, using two Emission scenarios of 4.5 and 8.5 in Bandar Abbas city which is located in southern Iran.

Materials and methods: The coastal city of Bandar Abbas is located in the south of Iran. In this study, the data collected from the Synoptic Station of Bandar Abbas were used. The historical observational data for the basic period from 1982 to 2005 included the daily temperature and precipitation. As for future data, the period considered was from 2016 to 2075. As this study sought to investigate the role of temperature and precipitation in the future average and bad conditions of the region, The Emission scenarios of 4.5 and 8.5 were taken into account. To investigate the effects of climate variation, the output of CMIP5 models was used. During the model selection in the CMIP5 project, the models which included the daily data were determined. In this study, three models were used to evaluate the temperature and precipitation. Considering the fact BC-Mean and

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variation Factor-Variance were the selected methods of the study, four GCM daily temperature and precipitation downscaling methods were used at the station scale. To evaluate the efficiency of the downscaling methods, a mean relative error (MRE) was, in addition to RMSE and MAE statistical coefficients, applied to determine the experimental similarity quantity between the observations and the downscaling.

Results: Based on the results obtained from the downscaling of each model, the MPI-ESM-MR model was found to have the least error rate and the most similarity with the synoptic station under study. From among the downscaling methods, the BC method proved to make more mistakes in limit values than the CF method (Chisanga et al, 2017). Based on the results obtained from four downscaling methods, CF-Variance and BC-Mean were selected for downscaling the precipitation and the temperature in this study, as they had the min error in terms of MRE, RMSE, and MAE, and possessed the max, average, and min amounts in comparison with those of the station; a result which is consistent with the findings of Wang et al (2016). Based on the 4.5 scenarios, it could be argued that from 2016 through 2045, the increase in precipitation variations has been low, and this is evident especially in those months with high rates of precipitation, with the maximum increase reported as 0.26 percent for May- June precipitation. As found by the Emission scenario of 8.5, during both time intervals of 2016- 2045 and 2046- 2075, the percentage of the rainfall variations from February to June was low and limited. In the time interval of 2016- 2045, an increasing trend of 2.34, 9.89, and 3.8 percent were found in January, September, and October, respectively. Therefore, the amount of precipitation during both time intervals indicated a reduction in precipitation in May and March, which are normally considered as high rainfall months, while an increase in precipitation forecast percentage was observed in September and October. The findings also suggested that based on scenario 4.5 and 8.5, the chances for an increase in precipitation in rainy seasons (autumn and winter) are minimized, and in seasons with normally least amount of least rain, the chances are maximized. It was also found that based on scenario 4.5, most of the changes occurred during those two time periods in the minimum temperature (-2.2 and -1.2 C), average temperature (0.4 and 1.04 C), and maximum temperature (0.1 and 0.6 C) respectively. According to scenario 8.5, most of the changes in temperature parameter occurred in the maximum temperature (13 and 13.8 C), average temperature (11.6 and 12.3 C), and minimum temperature (7.7 and 8.2 C) respectively during those periods.

Discussion and Conclusion: Taking the results of the study regarding climate in both scenarios, an increasing trend in temperature parameter was observed. As suggested by findings of the studies carried out by Tavousi (2016), Masoompour Samakosh et al (2016), Alijani et al (2007), Alijani (1995), and Najar Salighe (2006), precipitation in the southern district of Iran is partly influenced by the monsoon low-pressure tabs of India which starts at the beginning of June and continues to the beginning of October. The first day of these rainfalls is different each year. It could, therefore, be argued that the reason behind the increase in precipitation rate in those months which are typically characterized by low precipitation rate is an increase in the monsoon low-pressure system of India during the future time interval. This is consistent with the findings of a study carried out by Turner (2013) who found that the amount of India monsoon rainfall would increase in the future. Thus, it could be said that the percentage of the rainfall variations in July is, according to scenario 4.5, related to the time shift of the monsoon systems. As the findings of Schewe and Levermann (2012) indicated, the temperature is predicted to increase by the end of the 21st century and early 22nd century, and these frequent variations would lead to a 70% reduction in precipitation under the normal level of Indian summer monsoon system. Moreover, the begging of the monsoon system in southeast Asia may have 15 days shift in the future (Ashfaq et al, 2009؛ Loo et al, 2015). According to scenario 8.5, the results found for the variation trend of the time and precipitation parameters are in line with the findings reported by Schewe and Levermann (2012), and Loo et al (2015). Therefore, in studies on the effects of climate variation which are only based on one scale decline method, we should be careful in interpreting the results, a fact which is consistent with what Chen et al (2011) and Sarr et al (2015) found in their studies. Thus, in studies on climate variation, each result belongs only to the district studied, and their suggestive downscaling method may not fit other districts.

Keywords: Climate change, Emission Scenario, Bandar-Abbas city, CMIP5, Downscaling.