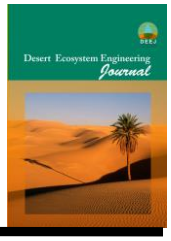
DEEJ (2021) 10 (33) 119-133

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir



SPEI-based Projection and Analysis of Drought's Spatiotemporal Characteristics Using GCM (CanESM2)

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Received: 31/07/2019 Accepted: 02/01/2022

Extended Abstract

Introduction: Climate change conditions have been deteriorated in recent years due to increasing emissions of greenhouse gases, whose negative effects on human societies are one of the major concerns in 21st century, leading to introduction of several scenarios for predicting the climate parameters affected by increasing emissions of greenhouse gases. Therefore, this study sought to investigate the effects of climate change on prospective drought in Tehran province using the Standardized Precipitation and Evapotranspiration Index (SPEI). To this end, daily climate parameters (T-min, T-max, T-mean, and precipitation) of eight synoptic stations were predicted in for the study period (1996-2017), using GCM-based emission Scenarios (RCP2.6, RCP4.5, and RCP8.5) extracted from the IPCC's Fifth report until 2112. Then, the drought's SPEI was calculated based on the predicted parameters, followed by the evaluation of the spatiotemporal characteristics of the drought. A general review of the results showed that the most severe drought would occur in Abali station in July 2073, which would be almost unprecedented in its kind. Moreover, Tehran city would experience more drought stress than other parts of the Tehran province in the coming years. It should be noted that according to the analysis of future drought's time series, "Very dry" months in future would have a 4-month displacement to the backward and would be shifted from September to May than what had been recorded in terms of time period.

Materials and Methods: This study attempted to predict the precipitation and temperature data at the synoptic station level based on climate change scenarios using SDSM exponential microscopy technique. The section 2 of the article introduces the study area and the stations concerned, the climate change scenarios, the SDSM microscopy model, SPEI drought index, and regional zoning model. In Section 3, the regional drought will be calculated and spatially analyzed based on SPEI index using the predicted data. Finally, the last section of the study is devoted to the summary and general conclusions. Based on the monthly average observational charts and forecasts at each station based on each scenario, it can be claimed that the drought phenomenon is moving backwards in the coming years. In other words, most of the stations are predicted to experience their driest year from September to October. However, according to climate change scenarios, May, June, and July are symbols of high drought months in the coming years.

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DOI: 10.22052/deej.2021.10.33.1

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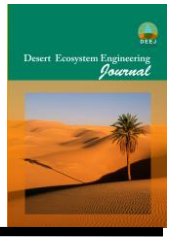

Results

Temporal Analysis

As one of the dimensions of drought characteristics, the detailed drought analysis offers very useful information regarding the intensity, duration, and frequency of drought. According to average monthly observation charts and forecasts prepared for each station in each scenario, it can be argued that the drought phenomenon is moving backwards in the coming years, according to which most stations are predicted to experience their driest years, especially in September and October of each year. However, the climate change scenarios revealed that May, June, and July would be the symbols of high-drought months in the years to come.

Spatial analysis based on scenario 2.6

At first glance, it could be said that in all months of the year, the Tehran city would suffer water stress and drought crisis. On the other hand, according to the images obtained, the drought would have a moving trend from January to July, shifting from the west to the east of the province. However, the trend would be concentrated in the west of Tehran province from August to January, except for the December.

Spatial analysis based on scenario 4.5 per month

Scenario 4.5 reported more severe climate change than Scenario 2.6. The remarkable point in the obtained images was the frequent continuation of drought in the center of Tehran province, i.e., Tehran city.

Spatial analysis based on Scenario 8.5 per month

Scenario 8.5 shows more different changes in the distribution of drought-prone areas in the coming years than previous climate change scenarios. One of the points to consider in this regard is the significant reduction in the frequency of droughts in the west of Tehran province, which is even lower than those of the center and east parts of the province, being almost the opposite of what was found in the 2.6 scenario.

Discussion and Conclusion: The comparison of data found for the observation years and the what was predicted for the upcoming years based on different scenarios shows that the frequency of droughts in the coming period. Therefore, if looked more closely, it could be found that the most severe and frequent droughts have occurred throughout the 7th decade of the 21st century, for which proper measures should be devised. The study's results also indicate that the probability of drought in the observation months will change more than what is anticipated, suggesting a seasonal retreat both in drought and wet season. Finally, according to the spatial analysis, it could be said that Tehran city will have higher temperature and precipitation stress (drought) than other parts of Tehran province. On the other hand, with the increase in altitude and the decrease in temperature, the severity of drought will decrease, whose effect on high altitude stations in this study was totally evident.

Keywords: Climate Change Scenarios, Forecasting, SPEI Drought Index, Spatiotemporal Analysis, Tehran Province.